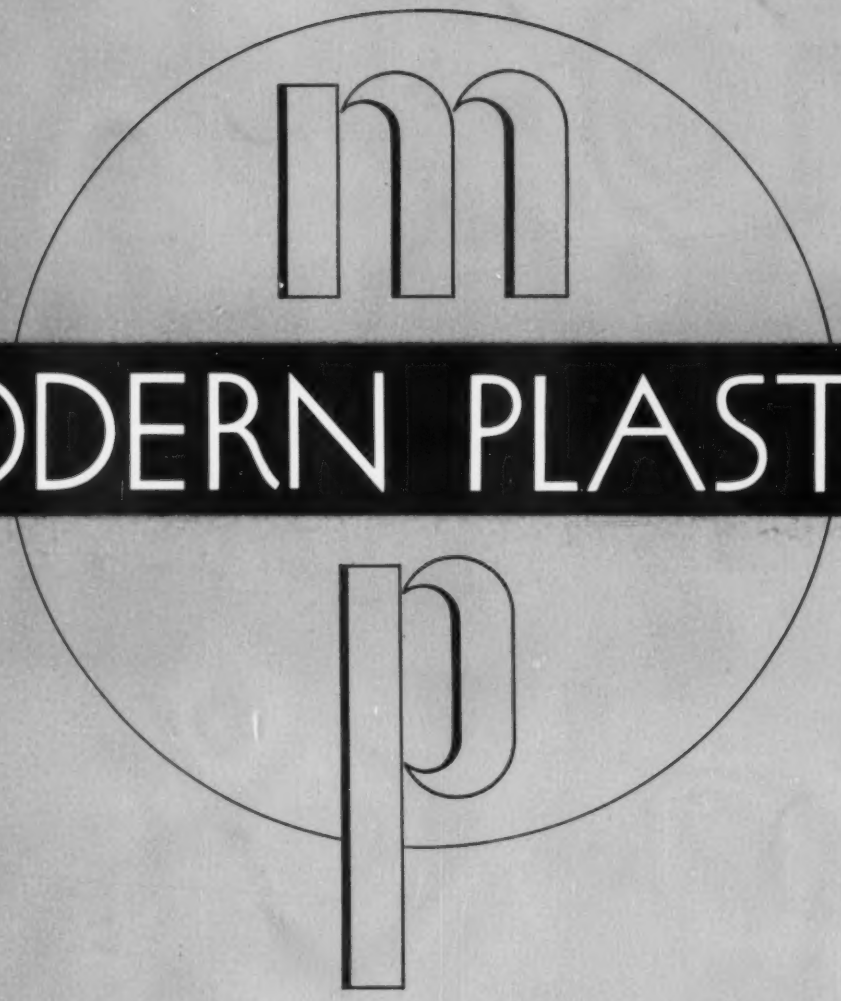


# MODERN PLASTICS

APRIL 1955

**How to Profit by Using**

**FORMED SHEET PLASTICS...Page 87**

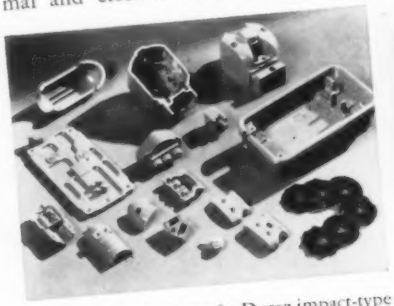
Product improvement
with **DUREZ** phenolics

# SINGER "Fashion" Discs prove WOMEN LIKE AUTOMATION too

● Delighted owners say the newest product of the world's oldest sewing machine company is "almost human," the way it turns out arrowheads, dominoes, or any of 101 stitch variations completely automatically. The trick is accomplished with little "Fashion" Discs molded of Durez, each one marked with the stitch it produces.

Singer finds Durez phenolics — the ultra-strong "working class" of plastics — so versatile in fitting physical, thermal and electrical requirements that motor housings, controls, terminal blocks, and lead plugs are molded of a special impact compound. The material contributes importantly to dependable operation, safety, and light weight.

It's another application of Durez phenolics that suggests there's no end to the possibilities these plastics offer in product improvements. To help you find them for what you make, Durez offers you the benefit of 34 years of specialized phenolics experience. Call on your molder, or write us.



Selection of a Durez impact-type phenolic for parts of the new Singer Automatic Sewing machine was dictated by balanced physical, electrical and thermal properties of this plastic. Singer says the six discs molded of another Durez phenolic help "save hours in every step of dressmaking."

*Specialists for 34 years in developing phenolic resins and plastics to meet the needs of industry.*

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**1204 Walck Road, North Tonawanda, N. Y.**

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With every factor a plus factor except the price, CATALIN STYRENE has proven itself, in many world marts, to be a good sale-or. Whenever, therefore, you plan launching a new product, we suggest you check the *gem of plastics.* It holds a master's papers!

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# MODERN PLASTICS*

April 1955 • Vol. 32 No. 8

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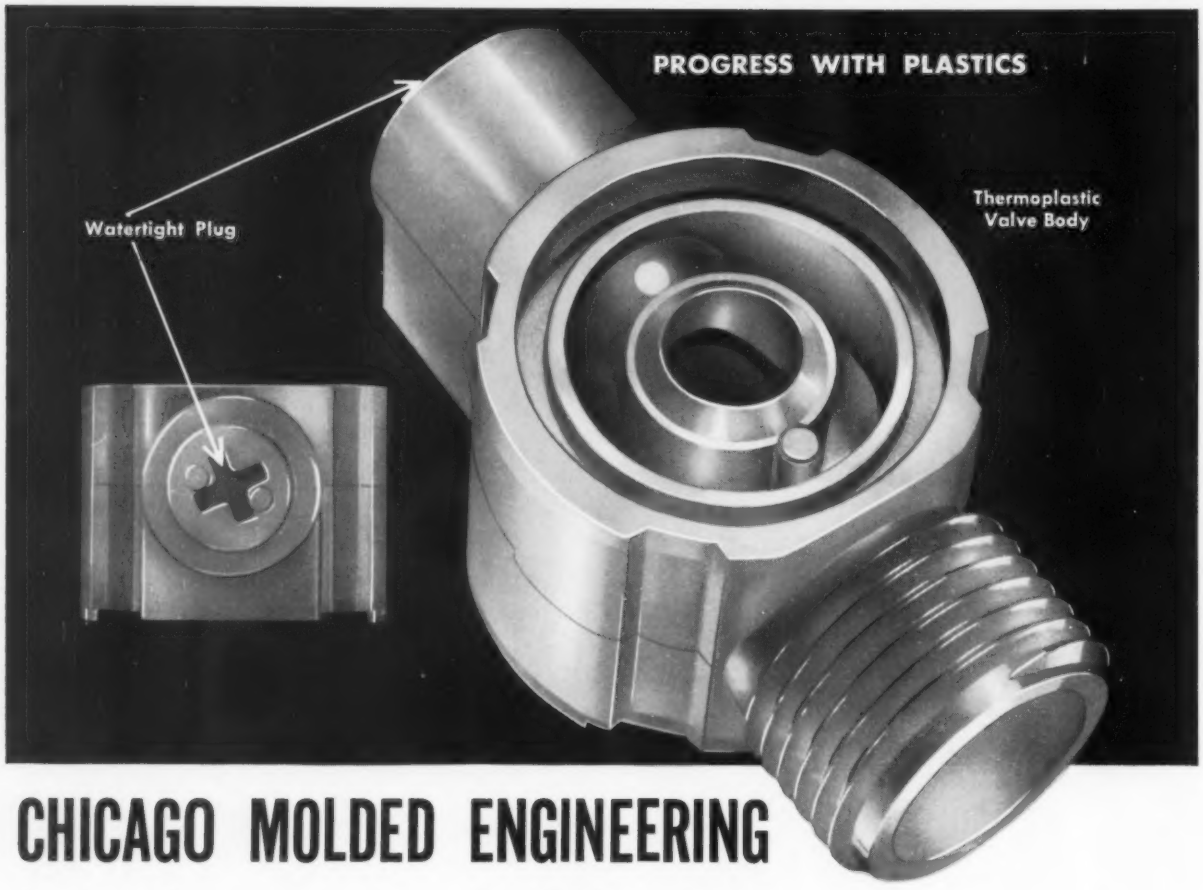


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° ° °

Of course, we don't always develop a whole new process to solve your problems. But we do make it part of our everyday business to help simplify your problems with suggestions that improve quality, cut costs, or both.

Discuss your next molding job with a Chicago Molded engineer. But remember: his experience can help you most *before your designs are final.*

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# EDITORIAL

## New People In Plastics

As the bases of plastics' application widen, industrial interest develops from quarters somewhat strange to the traditional set-up of the plastics industry.

Seven cases in point may be cited.

**First**, there is the new field of plastics tooling for the metal-working industries, including automobile manufacturers and home appliance makers. Here we find that cast phenolic, reinforced epoxies and polyesters, and ethyl cellulose are being used to replace steel dies—and being used, not by companies formerly interested in plastics in any way, but by people accustomed to making metal tools for metal working.

**Second**, there is the now opening field of vinyl-to-metal laminates in which the processor interest pattern is unique. Out of fifteen companies currently producing such laminates, eight have traditionally been in the metal or metal-treating field, four have been used to working with rubber, one has been a plastics coater, one is a venetian blind manufacturer, and one a luggage maker.

**Third**, there is the whole new field of plastics foams with such people as packing makers, tanneries, and again, specialty rubber companies involved.

**Fourth**, there is the field of adhesives, rapidly becoming a highly specialized, almost prescription business. Probably because of packaging interest, we find even food packers currently active in it.

**Fifth** is the field of plastics pipe and fittings in which metal pipe manufacturers are working, having seen the handwriting of competition on the wall.

**Sixth** is the thermoplastic sheet forming business into which are now moving a number of big operators in the sign, display, and advertising specialty field, and also into which are moving refrigerator, appliance, and automotive manufacturers with captive facilities.

**Seventh** is the field of reinforced plastics "repairs." In 1954 the biggest outlet for fibrous glass reinforcement was not in the molding or laminating field, but in the manufacture of plastics skin materials for wooden boats. Now this is again being expanded into epoxy-fibrous glass repair kits for metal automobiles.

The pattern of expansion in the use of plastics by broadening the bases of application is not always predictable. Sometimes it is a matter of a logical relationship of a new technique and a new application to plants already in existence and to skills which fit the process. Sometimes it is a matter of heavy equipment capital and working capital requirements for the use of a process. Sometimes it is a matter of a completely new operation beginning from scratch. And sometimes it is a matter of desire for diversification on the part of big enterprise.

Whatever the reasons, we are currently witnessing a broadening of plastics' application bases at a rate not seen in any year in the past decade.

And with our greatly expanded plastics materials facilities, the trend is very healthy.

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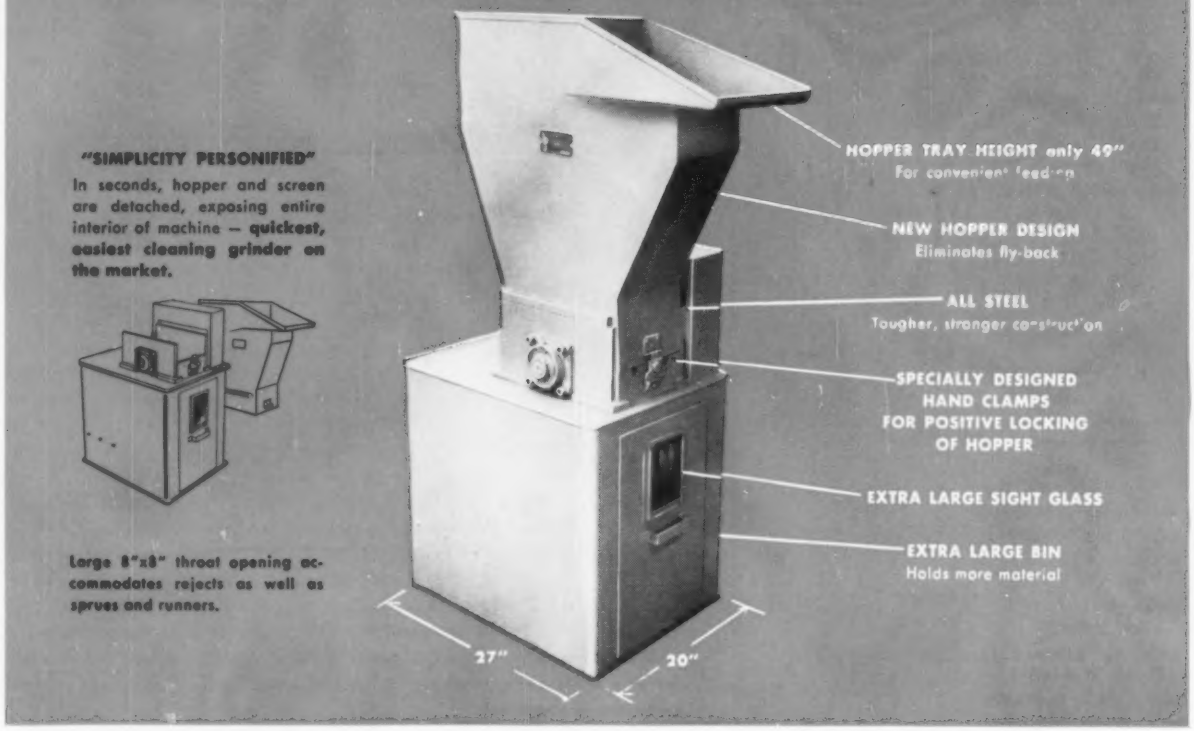
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## outperforms any beside-the-press grinder of comparable size and cost

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The M-100 is simpler to maintain, simpler to operate, simpler to clean than any machine on the market. Completely enclosed, it stays clean longer. The extra large sight glass shows operator when bin is filled. The extra large bin holds more, slips in and out with ease.

The M-100, first of the MARVEL LINE SERIES of all steel Ball & Jewell Grinders, is backed by the experience which has made Ball & Jewell leaders in the field for over 50 years. Standard equipment includes 1½ HP motor and starter, 2 or 3 HP optional. Casters included at no extra cost.

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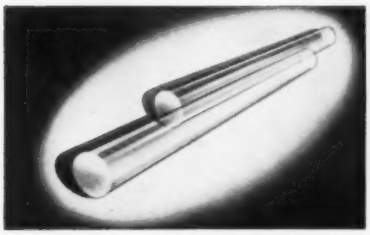

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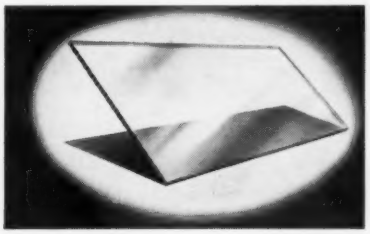

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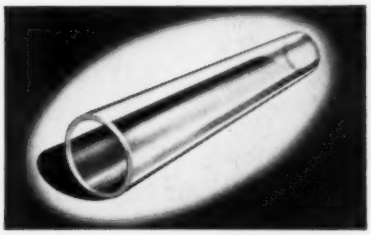

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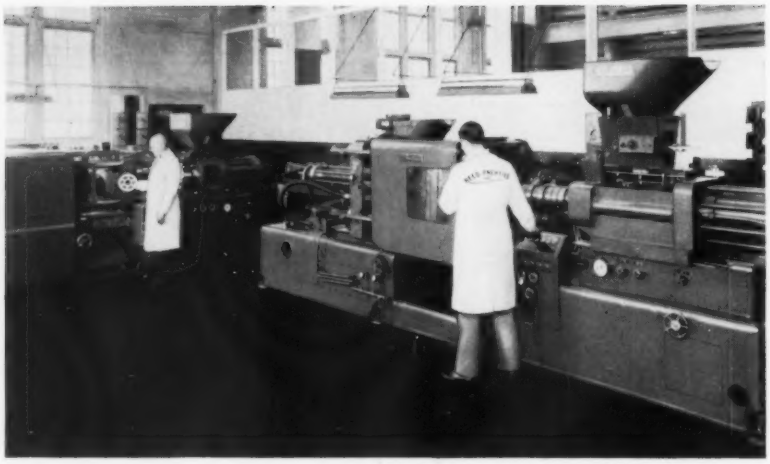

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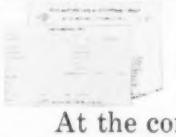

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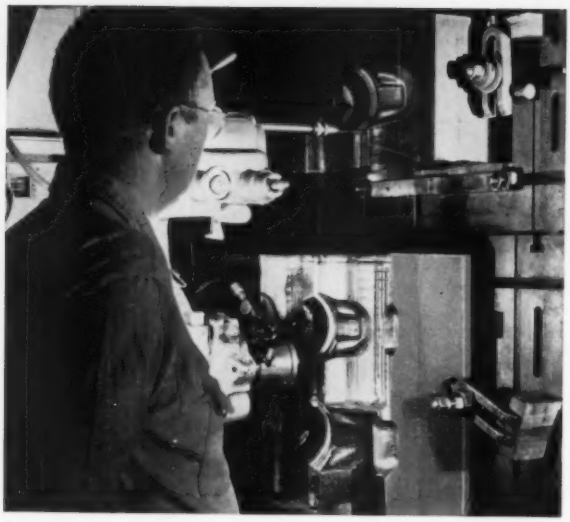
# 3 FINE STEELS for MACHINED CAVITIES



The master die shown in upper part of illustration is being reproduced in a duplicate machined-cavity mold, made of BTR. This manganese-chromium-tungsten steel is safe-hardening, and has high wear-resistance.

| | Hobability | Machinability | Core Strength | Wear Resistance | Distortion in Hardening | Application Pressure and Temperature |
|---|---|---|---|---|---|---|
| MULTIMOLD | Fair | Best | Fair | *Fair | Fair | Medium |
| BTR | Fair | Good | Good | Good | Good | High |
| A-H5 | Poor | Fair | Best | Best | Best | High |

*Good, when carburized and hardened.

**MULTIMOLD** is a balanced-alloy die steel, furnished either annealed or heat-treated. It's an easy steel to machine, even when heat-treated to 300 Brinell, and it can also be welded, providing good practice is used. Multimold combines high physicals, resistance to shock, and wear-resistance, making it an ideal steel for low temperature die-casting or plastic molding dies. If machined from the annealed condition, it may be heat-treated by quenching and tempering, with little danger of cracking or excessive decarburization. If a higher surface hardness is required, Multimold may be carburized and quenched, developing excellent surface hardness and core properties.

**BTR** is our standard grade of manganese-chromium-tungsten oil-hardening tool steel. The great thing about this grade is its safe-hardening quality. BTR is fine for long-run dies where the requirements are low distortion in heat-treatment, deep-hardening, and high wear-resistance. It's both easy to machine and easy to heat-treat. Dies made of BTR should only be machine-cut, except for very shallow cavities, which can be hobbed.

**A-H5** an air-hardening tool steel with a 5 pct chromium content, is a wise selection where maximum wear is desired for dies, with a minimum of size-change in heat-treatment. Wherever maximum abrasion-resistance together with minimum distortion is required, A-H5 is the first choice. Dies of A-H5 should be machine-cut, since hobbing with this steel calls for exceptional skill and in any case only very shallow cavities are obtainable.

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NO. 3 — 1955

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Extruded "Lucite" is now available to design engineers in increasing quantities. Use the coupon on the back of this page for complete information on beautiful, long-lasting Du Pont "Lucite".

## "Zytel" nylon is precision molded in intricate shapes requiring no secondary finishing

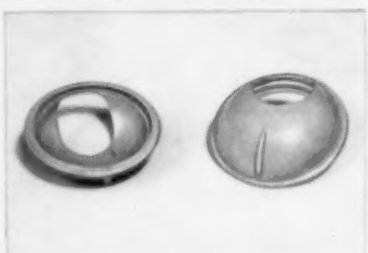
DU PONT "Zytel" nylon resin is being used throughout this new automotive air-conditioning system—for air deflector hoods, recirculated air intake grilles, air director shutters and grilles, and base units. "Zytel" gives these components many advantages over former units. Sweating, which was a major problem with the materials formerly used, is now eliminated through the use of "Zytel".

This engineering material is strong—extremes of heat, cold, and moisture don't affect its usefulness. Toughness is an important factor with the deflector hoods and air directors, which are handled and adjusted frequently. Moreover, "Zytel" damps vibration, operates quietly, assures long service life.

### Production Economies

Substantial production economies are also possible. Through

Corrugated extruded sheet of "Lucite" for light-diffusing ceiling. "Lucite" has excellent durability . . . maintains its beauty and original color indefinitely.



This air director hood assembly molded of Du Pont "Zytel" nylon resin is tough—frequent handling won't damage it. Molded by Bolta-Carpart, Inc., Owosso, Michigan.

precision injection molding, mass production of these intricately shaped parts is achieved. Parts made of "Zytel" need no secondary machining or finishing. Color can be molded in. There are no plated or painted surfaces to peel or chip. The smart appearance of these parts demonstrates how "Zytel" performs both functionally and decoratively.

Air director and shutter assembly. These molded parts of Du Pont "Zytel" need no machining or finishing operations.

### Expanding Use

"Zytel" and the other Du Pont engineering materials are finding an ever expanding market in the automotive industry. Their unique combination of prop-

OVER

*"Zytel" is the new trade-mark for Du Pont nylon resin.

DU PONT

PRODUCT ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

NO. 3 — 1955

"Zytel" (*continued*)

Molded parts of "Zytel" nylon resin are both functional and decorative. Colors are molded in—there are no painted or plated surfaces to peel or chip. Parts for this air-conditioning unit are molded by Bolta-Carpart, Inc., Owosso, Michigan.

erties enables automotive engineers to design parts that not only give improved performance, but also afford substantial savings in production and assembly costs as well. For complete information on these Du Pont engineering materials, clip and mail the coupon below.

### Investigate Du Pont engineering materials in your product development programs

ONE of the family of these versatile engineering materials is often a key factor in product improvement or new design.

The wide range of properties available with "Alathon"* polyethylene resin, "Lucite"* acrylic resin, "Teflon"* tetrafluoroethylene resin, and "Zytel"† nylon resin are helping solve industrial design problems.

**NEED MORE INFORMATION?**

CLIP THE COUPON for additional data on the properties and applications of these Du Pont engineering materials.

# New dyeing machine has bushings of Du Pont TEFLON® to resist high heat and pressure

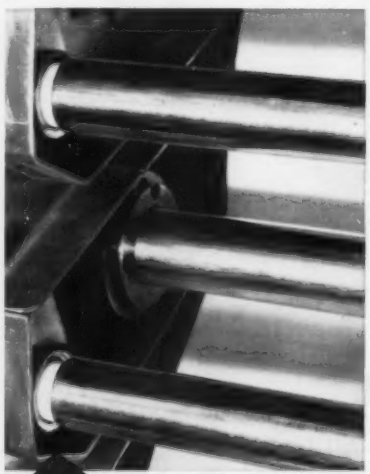
RECENTLY, a new machine called the "Barotor" was developed for dyeing synthetic fabrics. The "Barotor" improves the dyeing of synthetics by utilizing high temperatures and pressures. The designers were faced with the problem of choosing a material to be used for the bushings which carry the many stainless steel cross bars. These bushings could not be affected by the dyeing process, and should be able to function without lubrication.

### "Teflon" Solves Problem

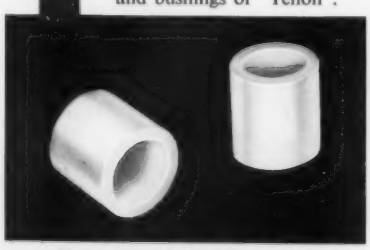
Bushings of "Teflon" tetrafluoroethylene resin were the answer. These bushings are unaffected by the high operating temperatures of the "Barotor" and the 25 lbs. per square inch pressure used. The corrosive chemicals in the dye solution can't corrode these bushings, as "Teflon" is chemically inert. As this unique engineering material is self-lubricating and has a very low coefficient of friction, the problem of lubrication was eliminated. Wear on both the bushings and the cross bar was minimized. Result: Frequent replacement of parts is eliminated, and a substantial saving of time and money is achieved.

"Teflon" is another in the Du Pont family of engineering materials which has a tremendous potential in the textile industry. For additional data on any of these Du Pont engineering materials, fill out the coupon below at the left.

The new "Barotor" for dyeing synthetic fabrics uses heat- and pressure-resistant bushings of "Teflon" . . . gives smooth operation despite corrosive chemicals in dye solution.



Close-up of "Barotor", showing stainless steel cross bars and bushings of "Teflon".



Bushings of Du Pont "Teflon", formed by economical extrusion techniques.

**E. I. DU PONT DE NEMOURS & CO. (Inc.) POLYCHEMICALS DEPARTMENT**
**Room 304, Du Pont Building, Wilmington 98, Delaware.**

*Please send me more information on the Du Pont engineering materials checked:* ☐ *"Zytel";* ☐ *"Alathon";* ☐ *"Teflon";* ☐ *"Lucite". I am interested in evaluating these materials for:*

NAME _____ POSITION _____

COMPANY _____

STREET _____

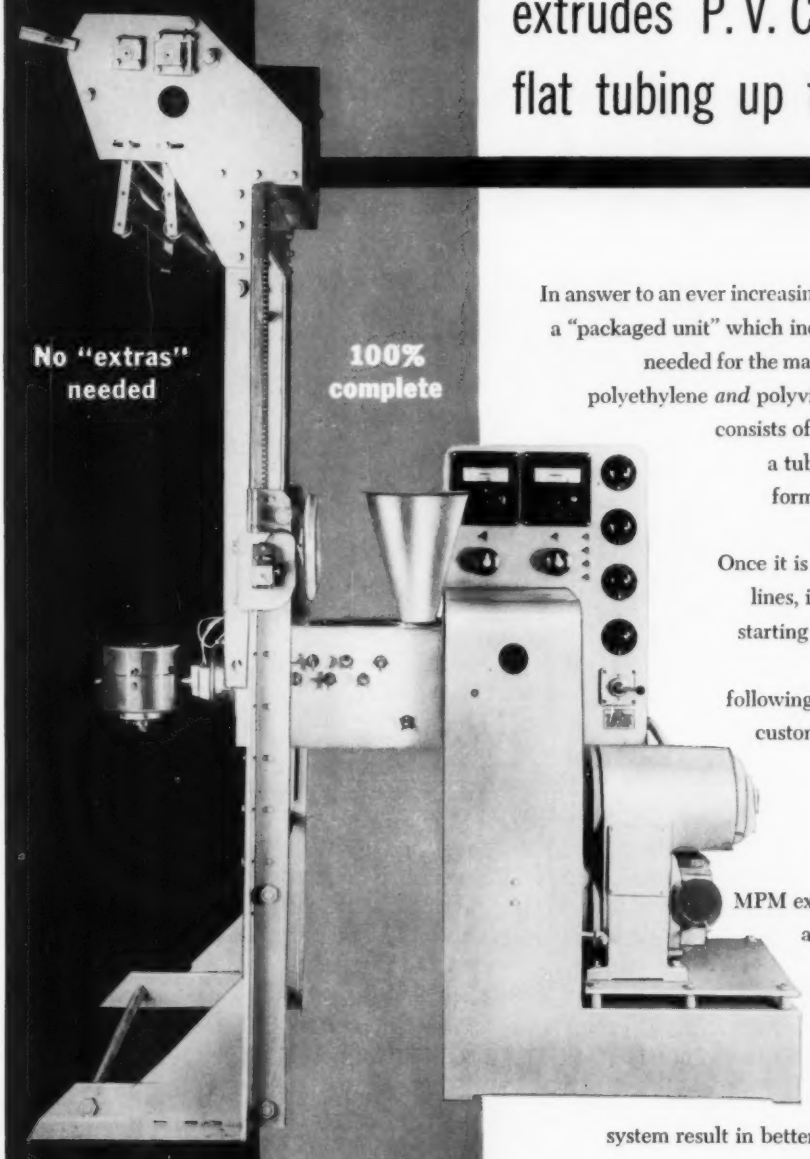
CITY _____ STATE _____

TYPE OF BUSINESS _____

*"Alathon", "Lucite", "Teflon" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.)
†"Zytel" is the new trade-mark for Du Pont nylon resin.

*As simple as A.B.C...*

# **MPM** "Packaged Unit" extrudes P.V.C. & polyethylene flat tubing up to 48″ wide



**No "extras" needed**

**100% complete**

In answer to an ever increasing demand, MPM has engineered a "packaged unit" which includes every piece of equipment needed for the manufacture of high quality roll flat polyethylene *and* polyvinyl chloride tubing. This set-up consists of a world-famous MPM extruder, a tubular film die, and a combination forming roll, pinch roll and take-up.

Once it is plugged in to electric and water lines, it can be placed in production by starting the heaters and motors and then feeding resin to the hopper. By following instructions furnished by MPM, customers without previous experience have extruded saleable roll flat tubing for packaging *the very first day.*

MPM extruders and auxiliary equipment are recognized all over the world for their versatility and long, trouble-free service. Their superior design and construction, and unexcelled heat control system result in better extruded products, produced at speeds which challenge comparison.

Details on this MPM "packaged unit" for extruding polyethylene and polyvinyl chloride roll flat tubing, and on individual extruders to meet your other requirements will be sent on request.

**Also exclusive manufacturers of the MPM-Traver Unit for making polyethylene printable. Write for details.**

**West Coast Representative**
4113 West Jefferson St., Los Angeles 16, Calif.

modern plastic machinery corp. mpm

15 Union St., Lodi, N. J., U. S. A.
Cable Address: MODPLASEX

# NEW VINYL-METAL LAMINATE

*is best made with* PLIOVIC

IT'S Sullvyne-Clad Metal Laminate – a new kind of basic material – wherein smooth or embossed vinyl sheeting is permanently wedded to steel, aluminum or magnesium sheet.

Sullvyne-Clad is a prefinished sheet that can be punched, stamped, bent or otherwise formed, without damage to the covering or bond. It opens up a new field of application for vinyl sheeting in the fabrication of a wide range of metal products.

Sullvyne-Clad results from a precise process developed by O'Sullivan Rubber Corporation. A major factor in its commercial feasibility is PLIOVIC – the easy-processing polyvinyl chloride resin. PLIOVIC best meets the necessarily tight specifications on uniformity, processability, heat stability and freedom from gel particles.

The particular PLIOVIC used in Sullvyne-Clad is one of a family of resins designed to meet the increasing demand for easier processing without sacrifice of physical properties. Careful control of particle size, shape and distribution gives you better calendered, extruded or molded products at lower cost.

Samples, literature and full technical help on the use of PLIOVIC are yours by writing to:

Goodyear, Chemical Division, Akron 16, Ohio

CHEMICAL GOODYEAR DIVISION

Chemigum, Pliobond, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

The Finest Chemicals for Industry — CHEMIGUM · PLIOBOND · PLIOLITE · PLIO-TUF · PLIOVIC · WING-CHEMICALS

PLIOVIC...another quality product by Goodyear Chemical Division

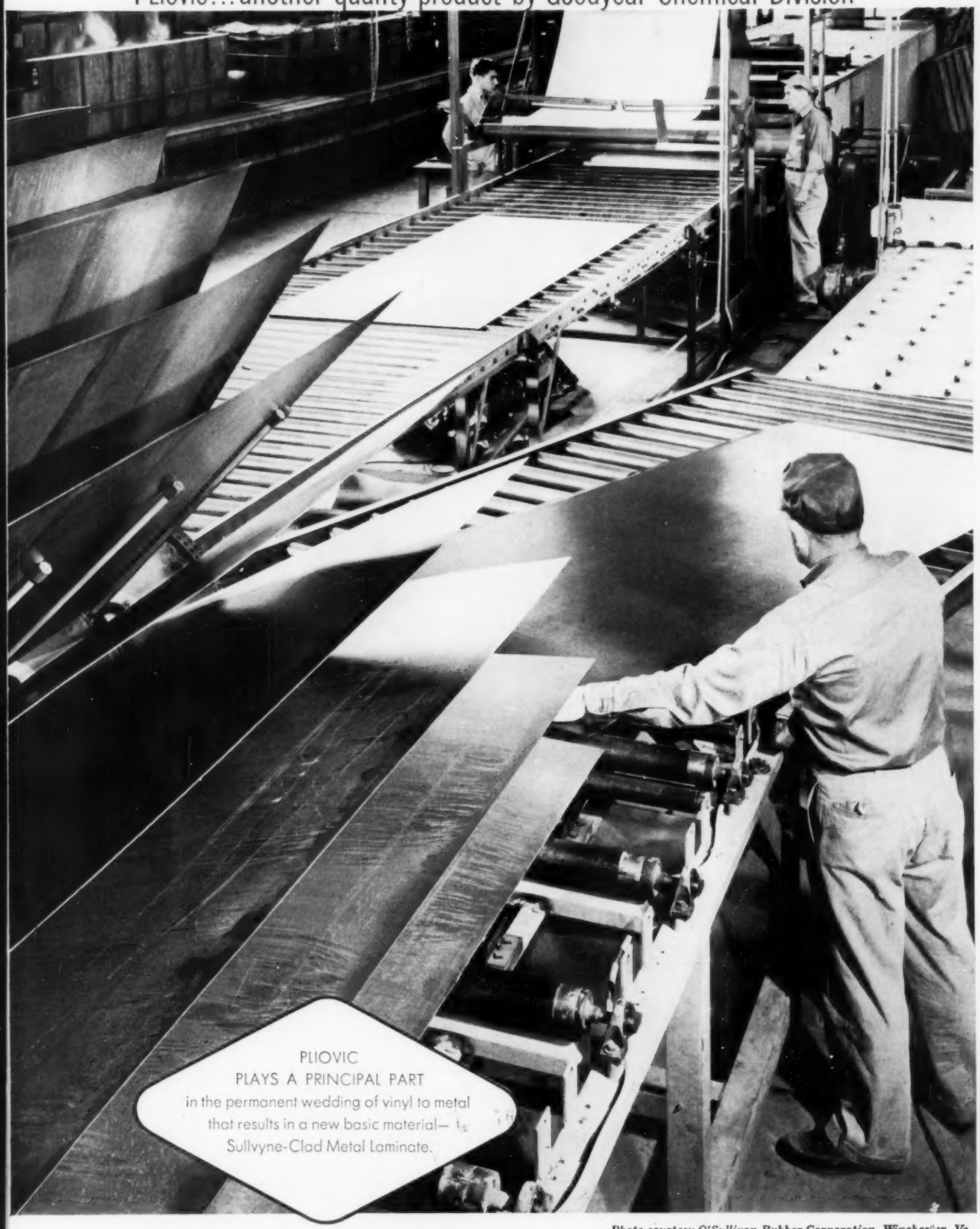
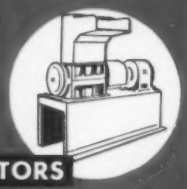

PLIOVIC
PLAYS A PRINCIPAL PART
in the permanent wedding of vinyl to metal
that results in a new basic material—
Sullvyne-Clad Metal Laminate.

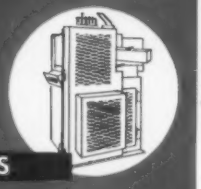
*Photo courtesy O'Sullivan Rubber Corporation, Winchester, Va.*

Sullvyne-Clad—T. M.
O'Sullivan Rubber Corporation, Winchester, Va.

# In Plastics Reducing Machinery, Look to CUMBERLAND for the COMPLETE LINE



GRANULATORS



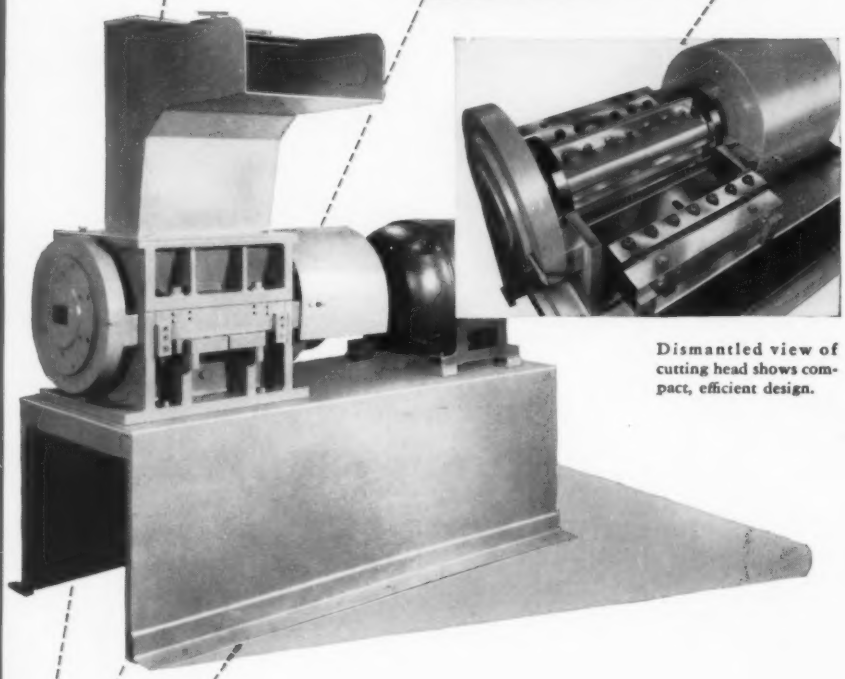
DICERS

CHOPPERS

PREBREAKERS

# MODEL 20 All Steel Granulator

CUSTOM ENGINEERED QUALITY BUILT





Dismantled view of cutting head shows compact, efficient design.

**1 HEAVY DUTY** — Large flywheel—thick all-steel weldments—deep welds—parts are of flawless wrought steel (not steel castings)—machine resists wreckage.

**2 LARGE THROAT OPENING** — 8 by 20" size.

**3 PRIOR BANDSAWING NOT NEEDED** — Machine specially built to handle large chunky parts such as bleeder scrap, cylinder purgings and heavy cast slabs of polystyrene, modified polystyrene and acrylic resins.

**CUMBERLAND** *Engineering Company Inc.*

BUILDERS OF BETTER MACHINES FOR THE PLASTICS INDUSTRY

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**Trapezo** - flies thru the air—
withstands extreme temperature changes

**Digesto** - resists heat

**Bulletini** - withstands impact

**The Great Pretzo** - intricate shapes

If it's functional, "do-something" plastic parts that you need – not decorative or gadget-type castings – we've got what it takes to please you. Don't you need an outfit which, by specializing in functional parts for years, has become pretty functional-type itself, with realistic approaches to capabilities of plastic parts, their tooling, moulding and regularly scheduled, on-time deliveries? Then talk to us!

Our range is the whole gamut of thermosetting plastics from phenolics and glass-reinforced material to fluorocarbons and epoxies. Our desire is to work with you on mouldings like you see here. And our address is right here for you to write to. Why not?

# KURZ-KASCH

*Specialists in Thermo-Setting Plastics for 37 years*

**Kurz-Kasch, Inc. • 1415 S. Broadway • Dayton 1, Ohio**

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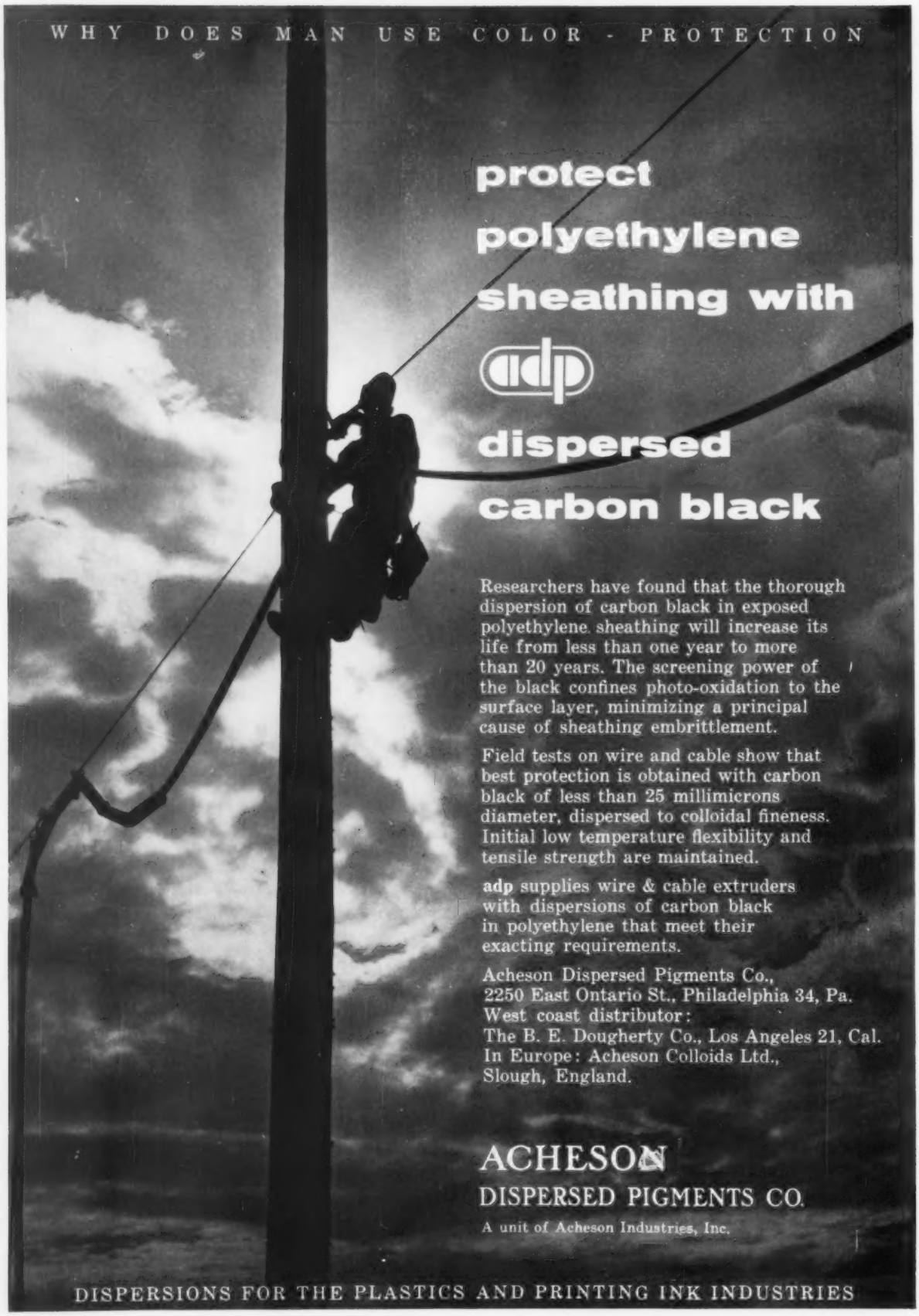
**EXPORT OFFICE:** 89 Broad St., New York City, *Bowling Green 9-7751*.


WHY DOES MAN USE COLOR - PROTECTION
protect
polyethylene
sheathing with
adp
dispersed
carbon black
Researchers have found that the thorough dispersion of carbon black in exposed polyethylene sheathing will increase its life from less than one year to more than 20 years. The screening power of the black confines photo-oxidation to the surface layer, minimizing a principal cause of sheathing embrittlement.
Field tests on wire and cable show that best protection is obtained with carbon black of less than 25 millimicrons diameter, dispersed to colloidal fineness. Initial low temperature flexibility and tensile strength are maintained.
adp supplies wire & cable extruders with dispersions of carbon black in polyethylene that meet their exacting requirements.
Acheson Dispersed Pigments Co.,
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In Europe: Acheson Colloids Ltd.,
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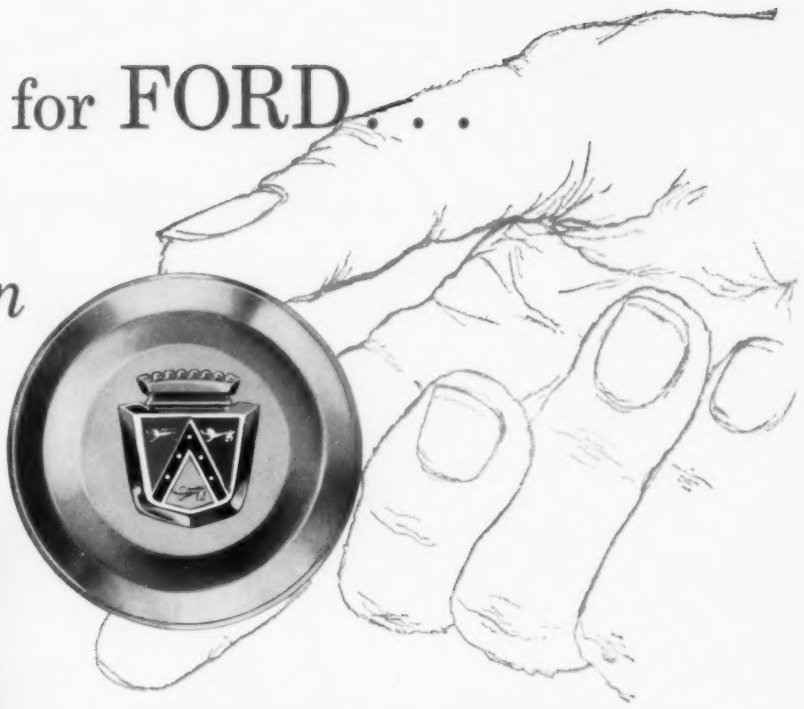
DISPERSED PIGMENTS CO.
A unit of Acheson Industries, Inc.
DISPERSIONS FOR THE PLASTICS AND PRINTING INK INDUSTRIES

# our *fourth* for FORD . . .

## *another horn button*



**CUSTOM MOLDED and FINISHED IN**

**ERIE**

**3 DIMENSIONAL PLASTICS**

A repeat order is the best evidence of customer satisfaction. This is the fourth horn button we have had the pleasure of producing for the history making Ford car in the last few years.

The 1955 Ford button reproduces the Ford shield in relief on a silver background. The red, blue, black, and silver design stands out with a jewel-like brilliance which can be produced only in 3 dimensional plastics.

ERIE PLASTICS has the "know-how," plus complete facilities for plating, spray painting, hot stamping and buffing to reproduce eye-catching designs, nameplates and trademarks into plastic gems of enduring beauty.

ERIE plastics

**ERIE PLASTICS DIVISION**

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# No Variations on This Theme

Kleestron WHITE 890

Kleestron White 890 polystyrene remains as white as the day it was produced. It will not fade or vary. It has all the qualities associated with Kleestron polystyrenes — easy flow characteristics — fast cycle times — matchless service. You're assured of trouble-free, pure white mouldings with Kleestron White 890.

## Kleestron POLYSTYRENE

*MOULDING MATERIALS AVAILABLE IN—*

**CRYSTAL CLEAR • STANDARD COLOURS • SPECIAL COLOURS • 604 COLOURING MIXTURE**

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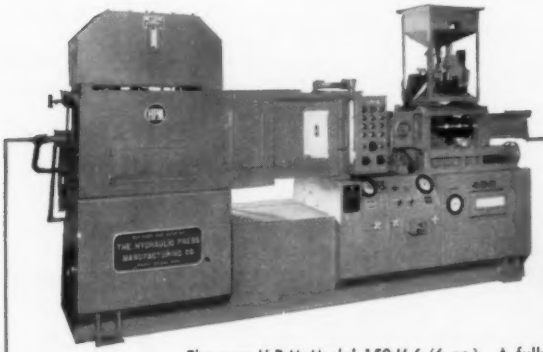
# "CEILING UNLIMITED"

## New H-P-M Automatics Boost Model Plane Production "Sky-High"

Model plane kits molded in one shot at Hawk Model Co., Chicago.

Here's a high-flying success story from one of the leading molders of model airplane assembly kits. "Our entire production has always been geared around H-P-M injection machines. Now, with two new H-P-M automatics, we're equipped to handle more production than ever." The Mates brothers, co-owners of Hawk Model Co., Chicago, prefer H-P-M's because they're dependable . . . fast . . . have extra large platens for family-type molds . . . plenty of daylight and stroke . . . straight line hydraulic clamp for easy mold set-up.

Take a tip from these boys and check on what the new high-speed H-P-M injection machines will do for you. Built in sizes from 6 to 400 ounces with mold clamping forces from 150 to 3000 tons, it's the largest and most comprehensive line of machines ever offered to the plastics industry. Write for Bulletin 5406, today.



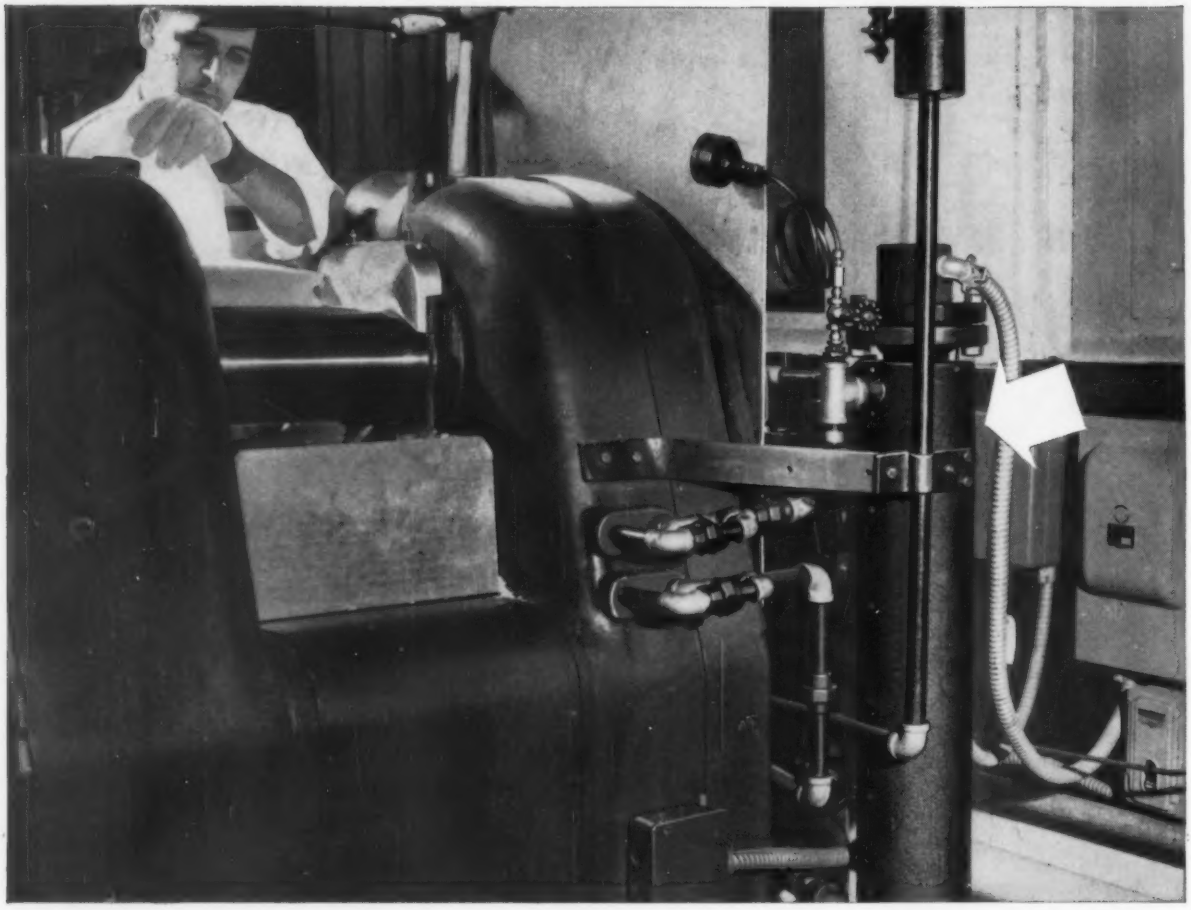
The new H-P-M Model 150-H-6 (6 oz.). A fully automatic machine equipped with low pressure mold protection and open cycle timer.

HPM

**THE HYDRAULIC PRESS MFG. CO.**

1010 Marion Road, Mount Gilead, Ohio, U. S. A.

Presses for Every Pressure Processing Application



## electrically heated oil eliminates high-pressure steam ...improves performance of plastic blending mill

To heat a plastic blending mill to temperatures ranging from 200 to 450°F was the problem faced by this manufacturer of extruded plastic films.

A steam system did not prove entirely adequate. For in order to supply the higher temperatures, it required high pressures. This put considerable strain on the expensive blending machine and other parts of the system. Losses in production time and material occurred while "waiting for pressure" during temperature changes.

Attaching a Chromalox Electric Oil Circulation Heater to the blending machine solved the problem . . . for electric heat generates high temperatures without high pressures. Heater inlet and outlet are attached directly to the steam lines. An oil circulating pump forces hot oil through the mill rolls. Installed capacity is 15,000 watts. Built-in automatic control measures out exact degree of heat to provide wide range of temperatures needed for fast, accurate blending.

Results are improved blending quality. Substantial increase in production. Considerable savings in raw materials. Reduction in maintenance.

This problem-solution-result approach has enabled us to help many manufacturers produce better, faster, at lower cost.

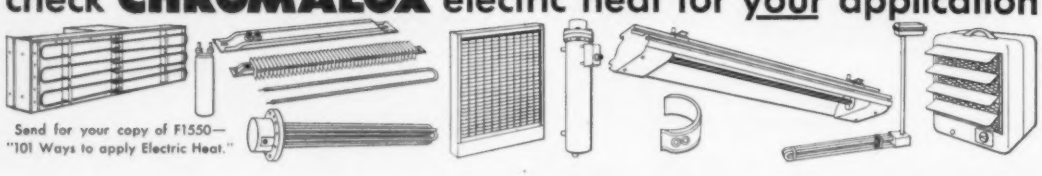
Always available to you are our research, engineering, design and modern manufacturing facilities. The world's largest factory stock of industrial electric heaters plus local stocks at strategic points. And a 33-city nationwide sales-engineering service.

Let us know your problem for controlled heat and we'll go all out to help you find the right answer—electrically.

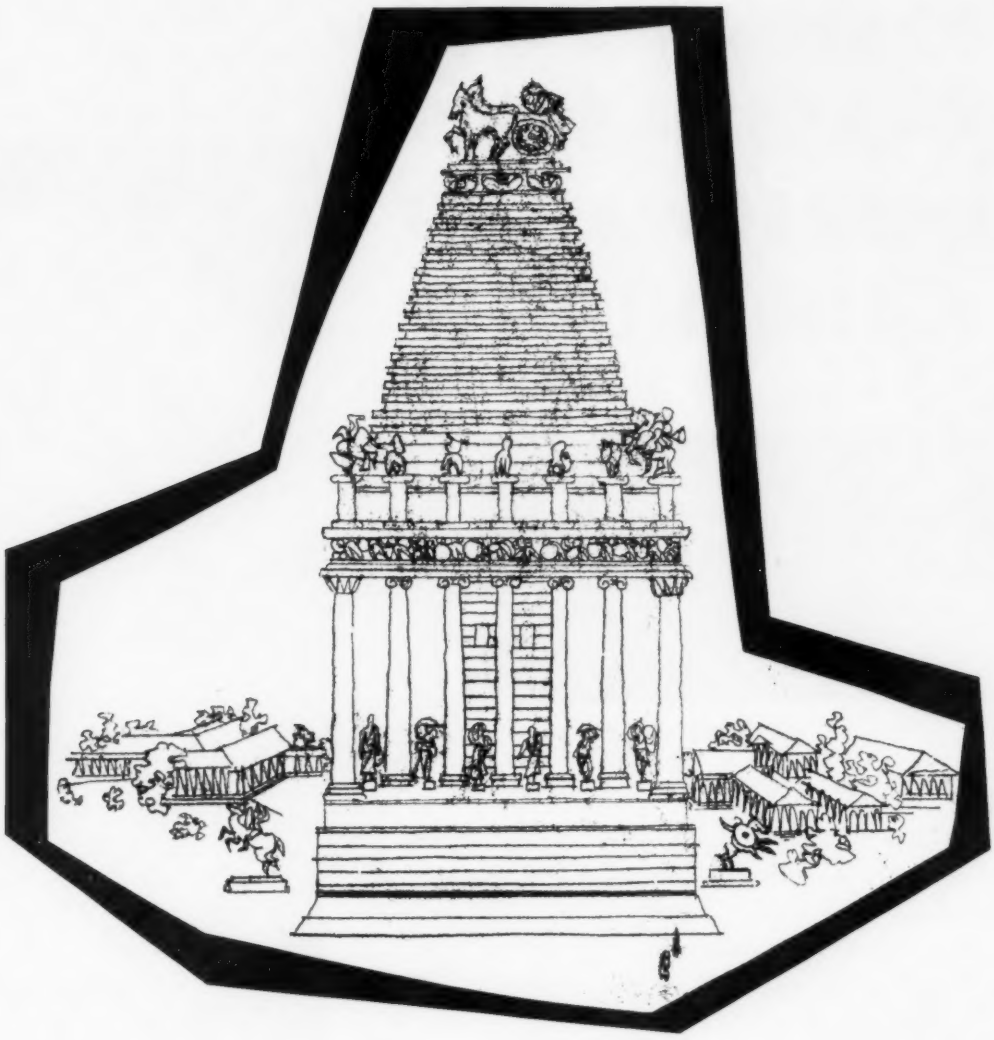
A-4437

**EDWIN L. WIEGAND COMPANY**
7503 Thomas Boulevard, Pittsburgh 8, Pa.

## check CHROMALOX electric heat for your application



Send for your copy of F1550—
"101 Ways to apply Electric Heat."



The second wonder of the ancient world was the 140 ft. high marble tomb of King Mausolus at Halicarnassus. It was adorned with a huge marble chariot drawn by four horses carrying images of the King and Queen. Built at the demise of the beloved ruler, it stood for 1,000 years. So famous was it that even today any imposing or elegant tomb is synonymously called a mausoleum.

Today—a synonym for phenolics could be Plenco. With constant research and rigidly controlled quality, Plenco has become prominent in the plastics industry.

**PLASTICS ENGINEERING COMPANY**
Sheboygan, Wisconsin

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

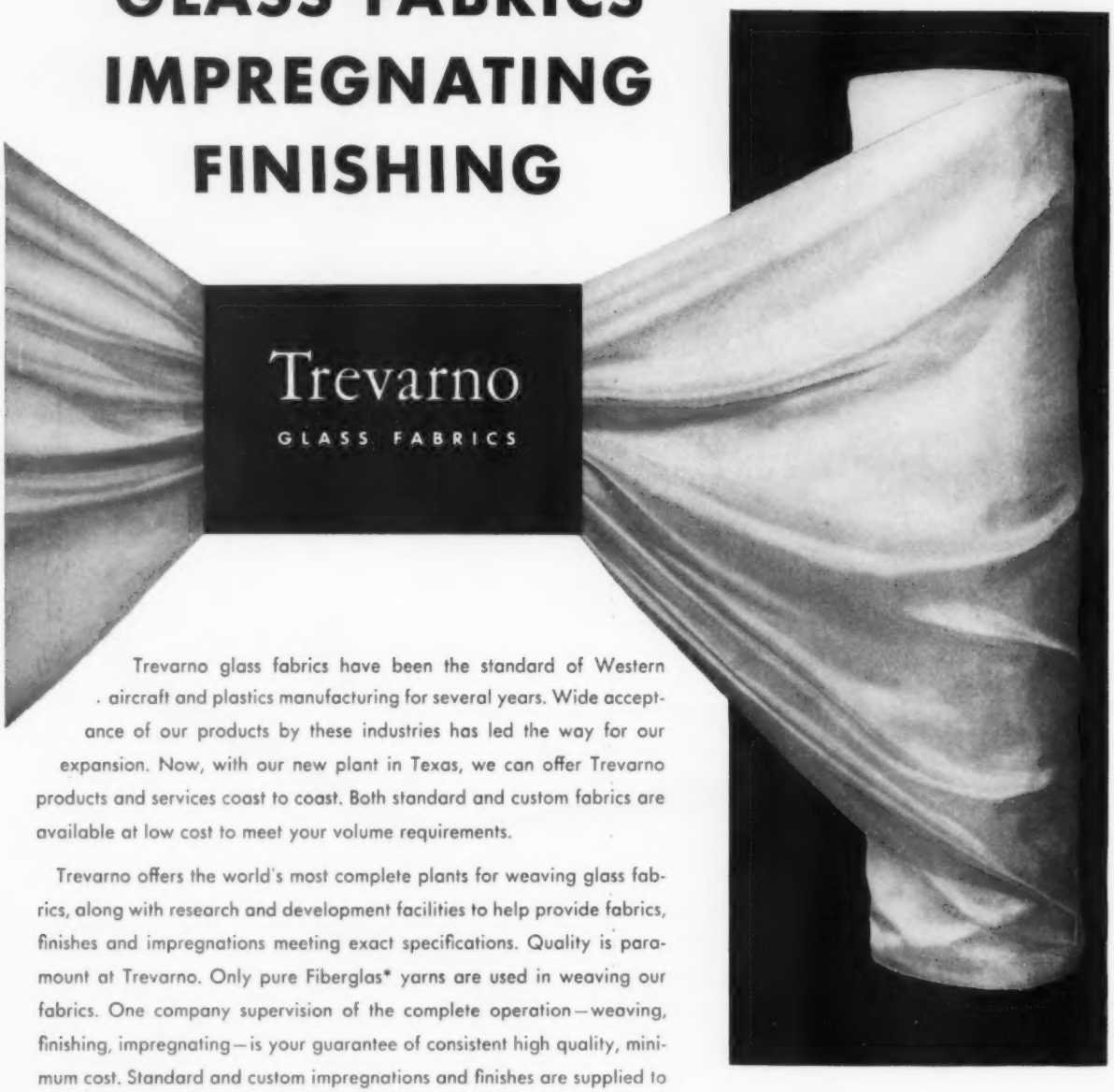


For molding escutcheons for Amana Freezers

# Now! Coast to Coast—TREVARNO!

## *A leading supplier of quality*

# GLASS FABRICS
# IMPREGNATING
# FINISHING




Trevarno glass fabrics have been the standard of Western aircraft and plastics manufacturing for several years. Wide acceptance of our products by these industries has led the way for our expansion. Now, with our new plant in Texas, we can offer Trevarno products and services coast to coast. Both standard and custom fabrics are available at low cost to meet your volume requirements.

Trevarno offers the world's most complete plants for weaving glass fabrics, along with research and development facilities to help provide fabrics, finishes and impregnations meeting exact specifications. Quality is paramount at Trevarno. Only pure Fiberglas* yarns are used in weaving our fabrics. One company supervision of the complete operation—weaving, finishing, impregnating—is your guarantee of consistent high quality, minimum cost. Standard and custom impregnations and finishes are supplied to precision specifications; fabrics are woven to your exact requirements.

*T. M. Reg.

***Write for information on your specific problems; or request our catalog.***

**COAST MANUFACTURING & SUPPLY CO.**
**BOX 71M · LIVERMORE · CALIFORNIA**
*Since 1867*

*Plants at*
LIVERMORE, CALIFORNIA
SEGUIN, TEXAS

## For molding escutcheons for *Amana* Freezers

*Photo courtesy Prolon Plastics Div.*

. . . here's what
**Prolon Plastics Division**
(PRO-PHY-LAC-TIC BRUSH COMPANY)
has to report about

# Cascade
## pre-hardened DIE STEEL

Following are comments on the use of Cascade precipitation hardened die steel by Prolon Plastics Division, Pro-phy-lac-tic Brush Co., in the above molding job at the Prolon plant in Florence, Mass.

*Photo courtesy Amana Refrigeration, Inc.*

1. *Cascade's excellent finishability saves time and labor in initial costly polishing . . . also less polishing time required when molds are removed from storage for re-use.*

2. *The mirror-like finish obtainable on Cascade surfaces results in an excellent high finish on molded parts.*

3. *Cascade's outstanding weldability allows mold rework, even in comparative large areas, to meet latest engineering design changes of molded part at minimum expense.*

Cascade's excellent finishability and weldability (a result of Latrobe's exclusive precipitation hardening process) have been noted by many leading molders and moldmakers. These are just two of several properties of Cascade that make it a preferred choice among prehardened steels for plastic injection molds. Call your nearest Latrobe representative today for complete details.

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Atlanta, Boston, Buffalo, Chicago, Cleveland, Dayton, Detroit, Hartford, Los Angeles, Milwaukee, Newark, Philadelphia, Pittsburgh, St. Louis, St. Paul, Toledo

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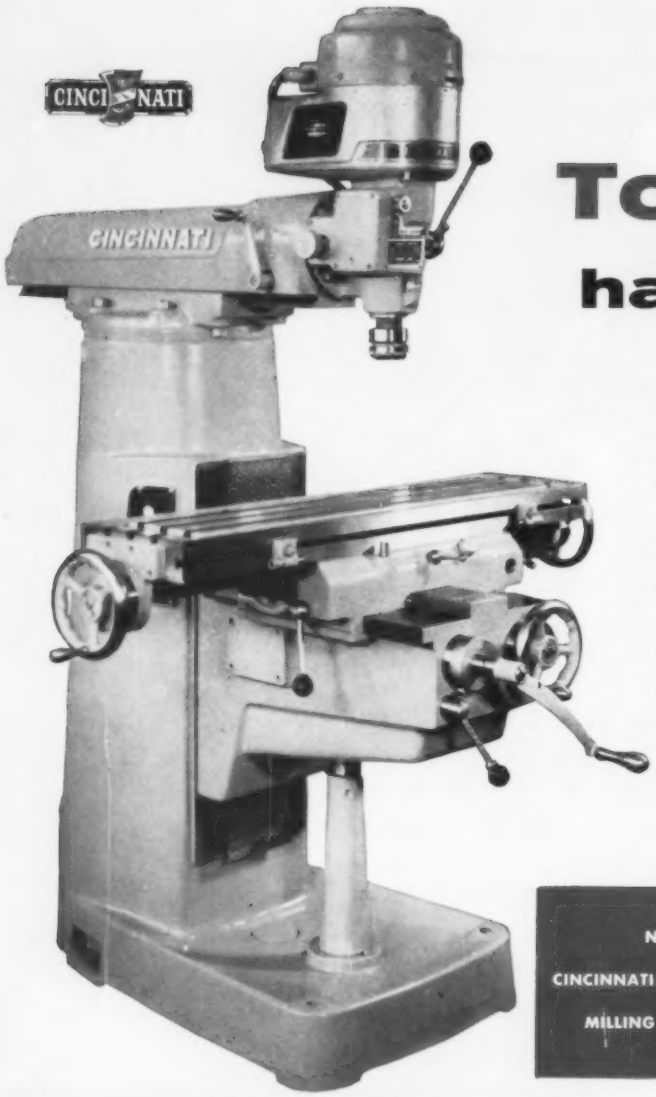
LATROBE, PA.




# The new Toolmaster has everything

. . . and there's a good reason. Before a single drawing was put on paper, our market research engineers went into shops everywhere, asking what was wanted in a small manual feed toolroom milling machine. Operators, tool engineers, machine tool buyers, maintenance supervisors . . . all had a voice in the design of the new CINCINNATI Toolmaster. Yes, there's a very good reason why these new milling machines have everything desired for fast, low-cost milling operations in toolrooms, contract shops, tool and die shops, repair departments, and others. Just take a look at the three typical features illustrated below. They were operator-approved in actual field tests; management-approved in cost-of-production records. Would you like to have more information? Just write for new four-color catalog, No. M-1870-2.

**THE CINCINNATI MILLING MACHINE CO.**
**CINCINNATI 9, OHIO**

**NEW CINCINNATI TOOLMASTER MILLING MACHINE**

Built in three styles:

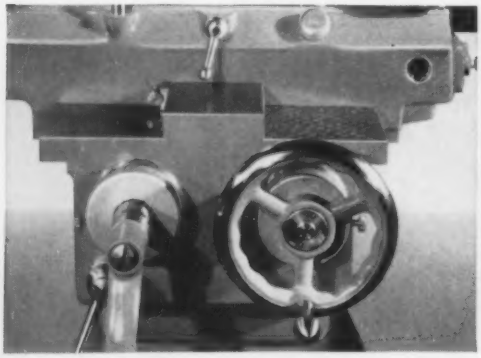
| | Range: |
|---|---|
| 1A—Manual feed to quill, 1 hp motor | 16" table traverse |
| 1B—Power feed to quill, 1 hp motor | 10" cross |
| 1C—Heavy duty head, 2 hp motor | 17" vertical |

# CINCINNATI

MILLING MACHINES • CUTTER SHARPENING MACHINES • BROACHING MACHINES • METAL FORMING MACHINES • FLAME HARDENING MACHINES OPTICAL PROJECTION PROFILE GRINDERS • CUTTING FLUID

**Extra Wide Knee**

Has two advantages: wide square gibbed bearing ways for maximum strength; narrow guide for smooth cross adjustment.

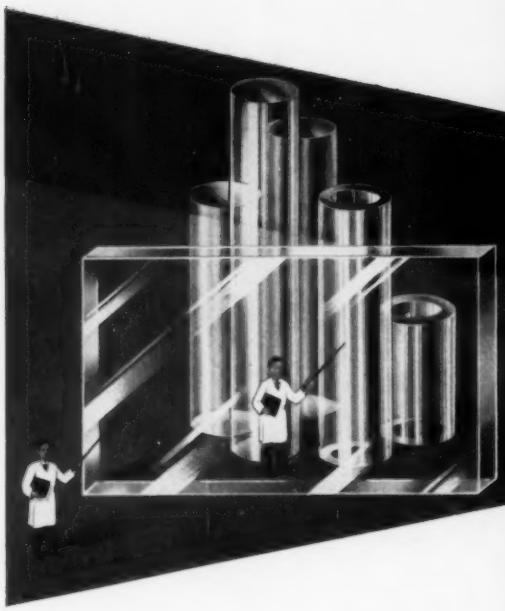


**Shaping Attachment**

Jobs that would often be assigned to another machine can stay right on the Toolmaster with the ruggedly-constructed Shaping Attachment.

**Oil-Shot Lubrication**

Saddle-table parts and way bearing surfaces are lubricated from centralized oil-shot system.



Celanese
**ACETATE**
- SHEETS
- FILM

Rohm & Haas
**PLEXIGLAS**
- SHEETS
- RODS
- TUBES

DuPont
**LUCITE**
- RODS
- TUBES

DuPont
**NYLON**
- RODS
- STRIPS
- TUBING
- SLABS
- DISCS

DuPont
**TEFLON**
- TAPE
- RODS
- TUBES
- SLABS

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**VINYLITE**
- RIGID
- SHEETS

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- TUBES

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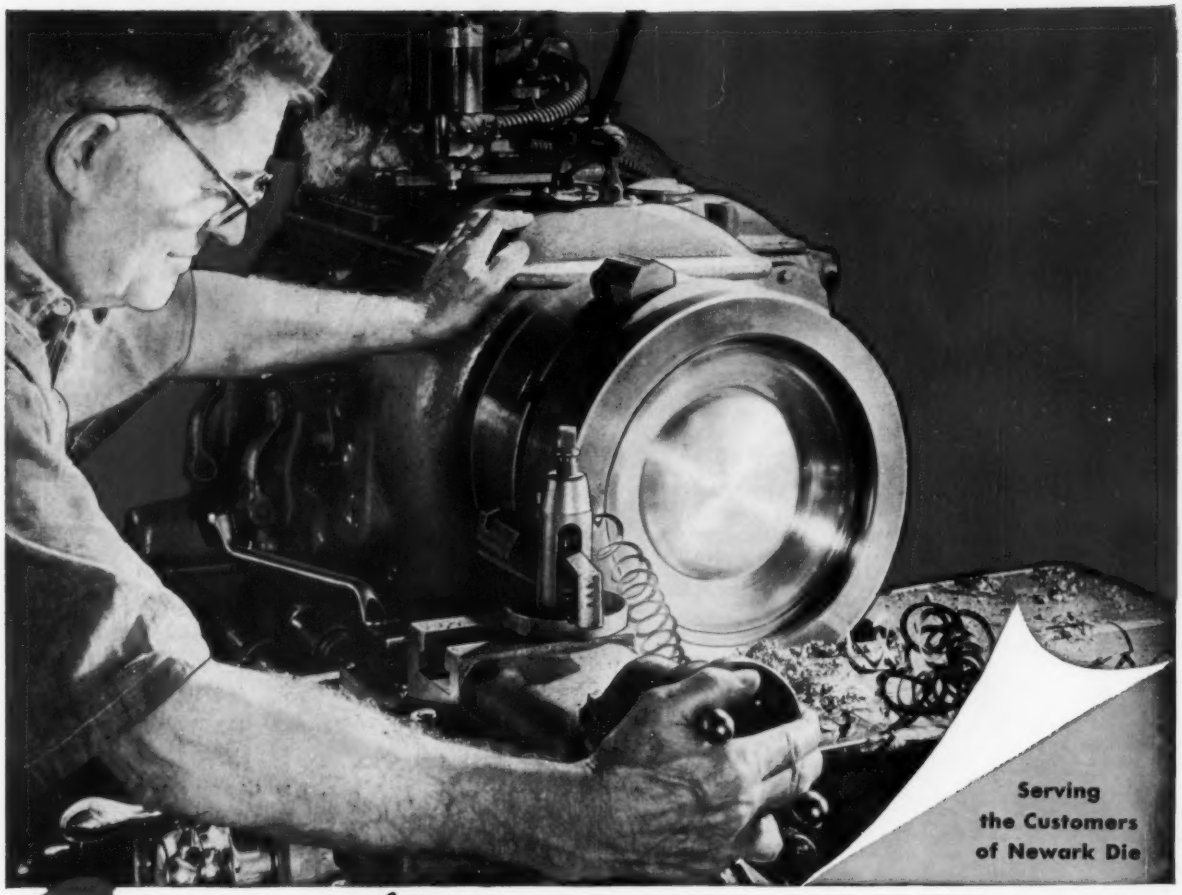


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Here at Newark Die Company, lathe work combines skilled craftsmanship and up-to-the-minute machine tooling —to bring the final touch of accuracy to the molds that are designed by Newark Die engineers.

A new plant expansion provides added floor space and improved materials handling facilities that permit prompter, more economical service on molds, hobs and hobbed cavities for the customers of Newark Die.

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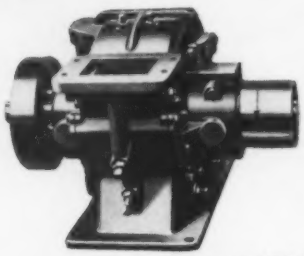
### *assures accurate samples... cuts laboratory sampling costs*

Sturtevant laboratory equipment have all the features of full-sized production machines with extra accuracy and wider range of adjustment built-in. They are fast... provide true samples of every batch processed.

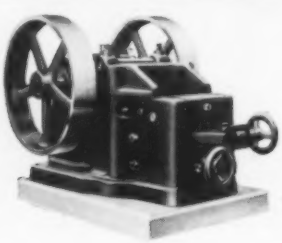
All Sturtevant machines have "open-door" accessibility which permits quick, thorough cleaning... prevents the possibility of previous batches from contaminating new samples. Their rugged construction assures round the clock operation with practically no maintenance.

Investigate Sturtevant equipment for your laboratories. They will help you cut sampling costs... improve product quality... increase sales. Write for catalog, today.



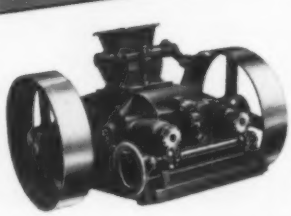
**LABORATORY SWING-SLEDGE MILLS**

Capable of reducing soft, moderately hard and tough or fibrous materials to any degree of fineness between 1 in. and 20 mesh. The patented "Open-Door" feature permits ready accessibility for cleaning.



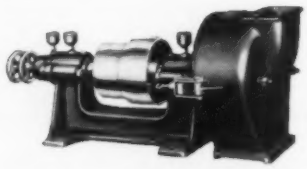
**LABORATORY JAW CRUSHERS**

Special Roll Jaw action simplifies close regulation of the product with capacities varying from 300 to 400 lbs. per hour at finest settings, to 1000 or 2000 lbs. when opened for coarser work. Each part of the crusher is accessible for quick and easy cleaning.



**LABORATORY CRUSHING ROLLS**

First designed especially for laboratory sampling work, Sturtevant Crushing Rolls are used regularly in many plants where there are limited out-puts. Range of output for the 8 x 5 size is from ½ in. to 20 mesh — and for the 12 x 12 size from ¾ in. to 20 mesh.



**LABORATORY SAMPLE GRINDER**

Laboratory Sample Grinders are of the "Open-Door" disc type and are capable of very fine work, producing products as fine as 100 mesh (coarser if desired) when working on dry, friable, soft or moderately hard materials. Simply turn hand wheel to provide product regulation from 10 to 100 mesh.

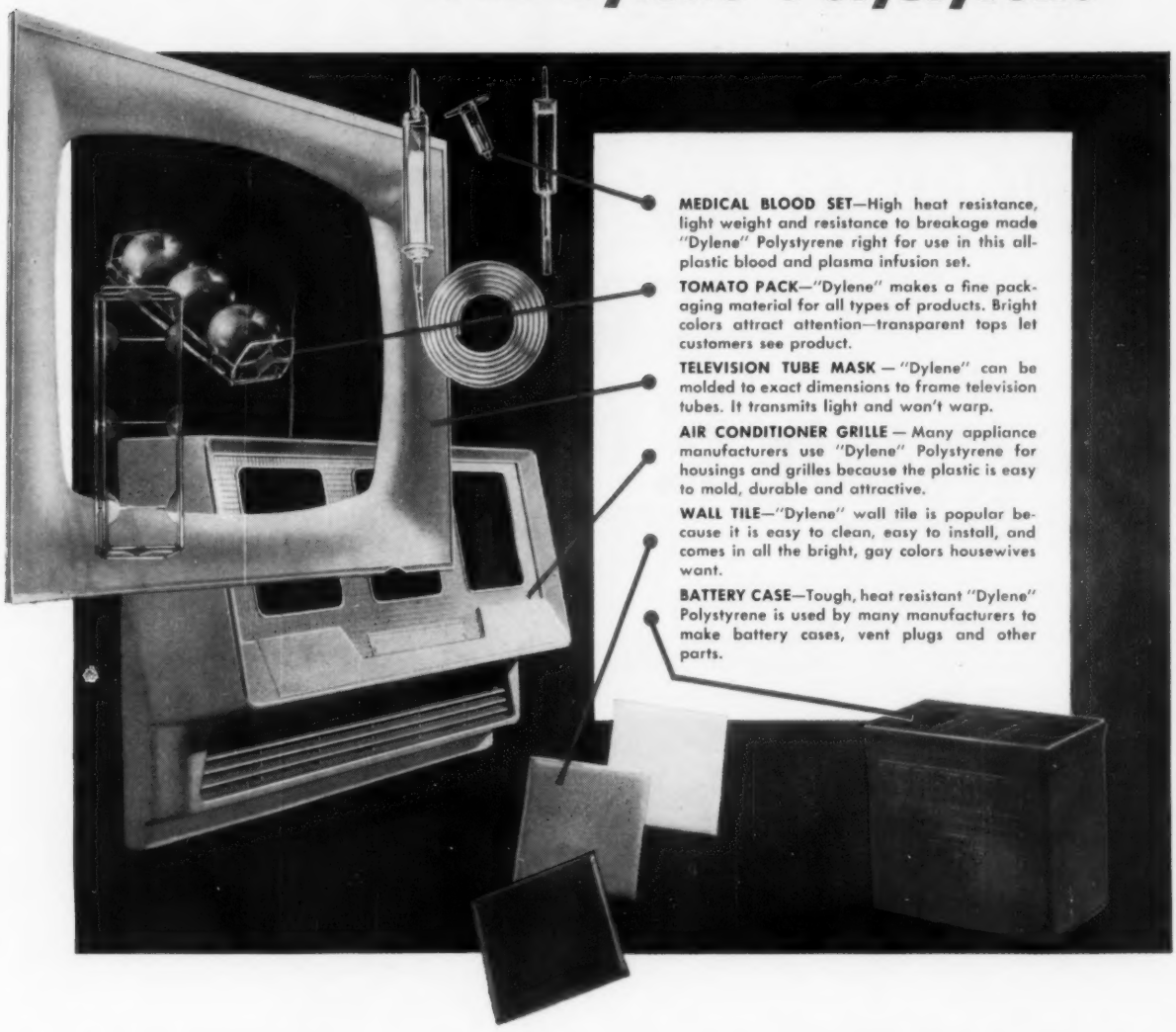
**STURTEVANT MILL COMPANY**

**110 Clayton Street, Boston 22, Mass.**

***Designers and Manufacturers of***

**CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS • MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS**

# All these products are made better with Dylene* Polystyrene



**MEDICAL BLOOD SET**—High heat resistance, light weight and resistance to breakage made "Dylene" Polystyrene right for use in this all-plastic blood and plasma infusion set.

**TOMATO PACK**—"Dylene" makes a fine packaging material for all types of products. Bright colors attract attention—transparent tops let customers see product.

**TELEVISION TUBE MASK** — "Dylene" can be molded to exact dimensions to frame television tubes. It transmits light and won't warp.

**AIR CONDITIONER GRILLE** — Many appliance manufacturers use "Dylene" Polystyrene for housings and grilles because the plastic is easy to mold, durable and attractive.

**WALL TILE**—"Dylene" wall tile is popular because it is easy to clean, easy to install, and comes in all the bright, gay colors housewives want.

**BATTERY CASE**—Tough, heat resistant "Dylene" Polystyrene is used by many manufacturers to make battery cases, vent plugs and other parts.

A TREMENDOUS VARIETY of products can be made better with "Dylene" Polystyrene—tumblers and trays, children's trucks, planes and dolls, battery cases, air conditioner grilles, radio cabinets and television masks. All of these products are tough, durable and may come in all the colors of the rainbow.

Koppers makes a full line of different types of "Dylene" Polystyrene — each featuring a different combination of desirable properties. Your choice depends on the function of your product. Choose the right type of Dylene and you will get such qualities as high impact resistance, low water absorption, dimensional stability, high heat distortion.

Chances are "Dylene" Polystyrene can improve your product or reduce production costs. A Koppers engineer can give you technical assistance in selecting the proper polystyrene for your product. Write us today for more information.

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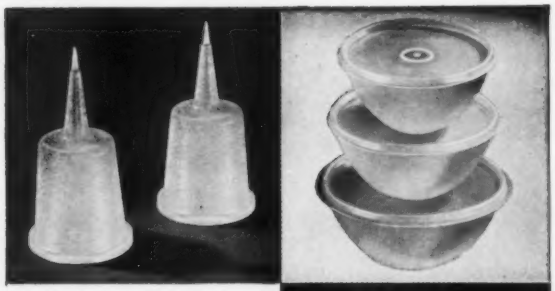
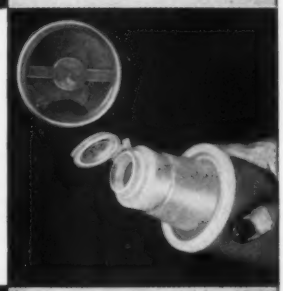
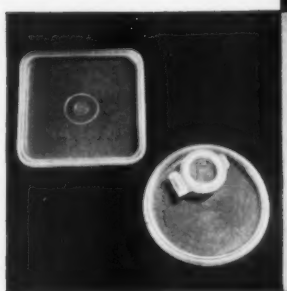


# NOBODY HAS AS MUCH EXPERIENCE AT MOLDING POLYETHYLENE AS TUPPER!





Tupper Seals are air and liquid-tight flexible covers. The famous Pour All and Por Top covers are designed for easy dispensing. They are made in sizes to fit all Tupperware containers.

The logical molder for you to consult regarding that product or package of yours which is to be made of polyethylene is Tupper. Tupper has done more than any other molder to make molded polyethylene a practical reality.

Aside from having designed, patented, and promoted successful seals, closures, and dispensers for polyethylene containers, the Tupper Corporation has vast experience in *every phase* of polyethylene packaging and polyethylene injection molding. This experience will be of major importance in improving your product, in reducing your costs, when Tupper goes to work for you.

Tupper's combination of experience, technical ingenuity, and the most modern equipment is at your service for the custom molding of your product in polyethylene. You can do no better than the best ...and the best at molding polyethylene is Tupper!

When equipped with Tupper Seals, Tupper Canisters, Sauce Dishes, Wonder Bowls, Cereal Bowls and Funnels in various sizes are the most versatile reusable containers you have ever seen.

TUPPER!
TRADE MARK

**TUPPER PRODUCTS ARE FULLY PROTECTED**

About 150 United States and foreign patents and patents applied for, plus numerous trademarks and copyrights, cover the design and manufacture of the various types of Tupper Seals and other Tupper Products. Unauthorized manufacture of items covered by Tupper patents will subject infringers to prosecution.

## TUPPER CORPORATION

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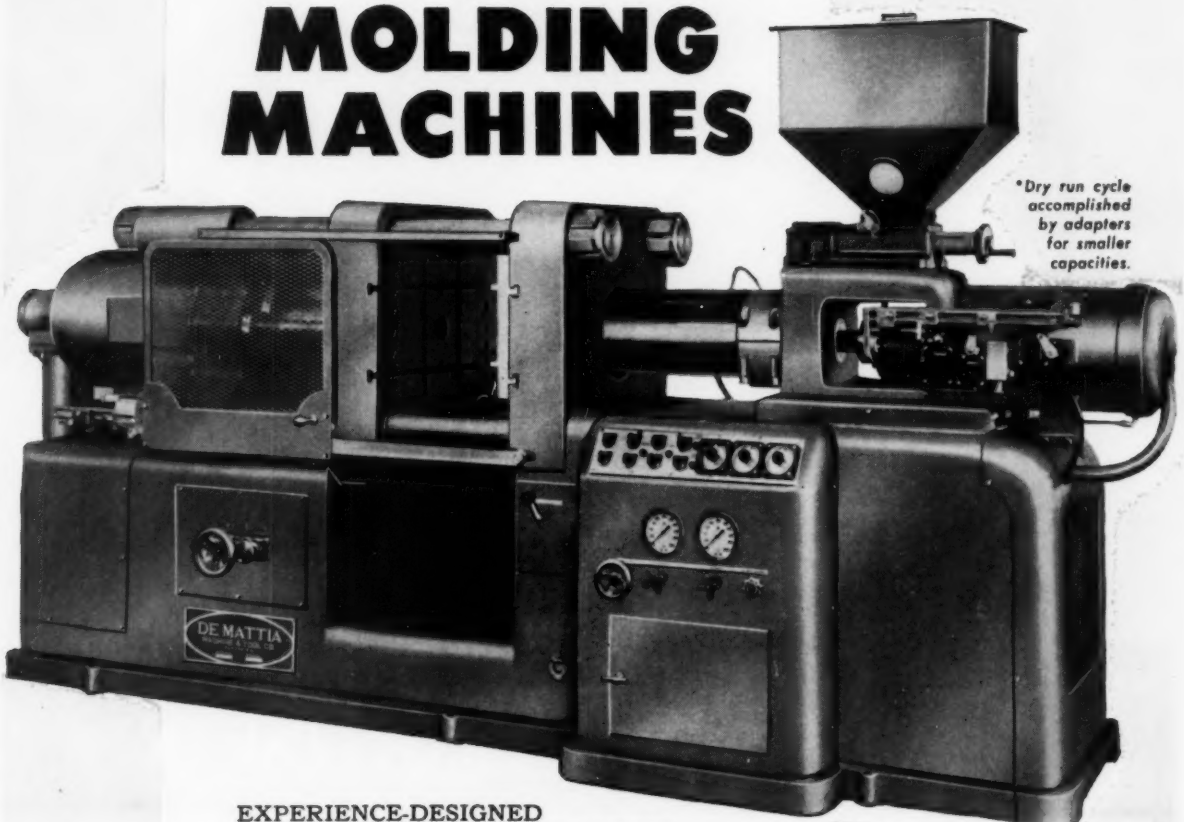
# MOLDING MACHINES

IMPROVED DESIGN

FULLY HYDRAULIC OPERATION

UP TO 6 CYCLES PER MINUTE*

16 OUNCES BY AUTOMATIC PRE-PACKING




*Dry run cycle accomplished by adapters for smaller capacities.

**EXPERIENCE-DESIGNED TO SAVE YOU TIME AND MONEY**

the new Model M Molding Machines are another step forward in molding production. These high efficiency injection machines help you meet competition... are expressly designed to increase your molding production and cut your molding costs. Series M machines offer fully hydraulic operation, up to 6 cycles per minute on smaller shots and shots up to 16 ounces by means of automatic pre-packing!

**Available in 8 and 12 oz. Models. The De Mattia Line also includes 4 oz. Verticals, 3 oz. Horizontals and Various Models of Scrap Grinders. Write for Illustrated Bulletins.**

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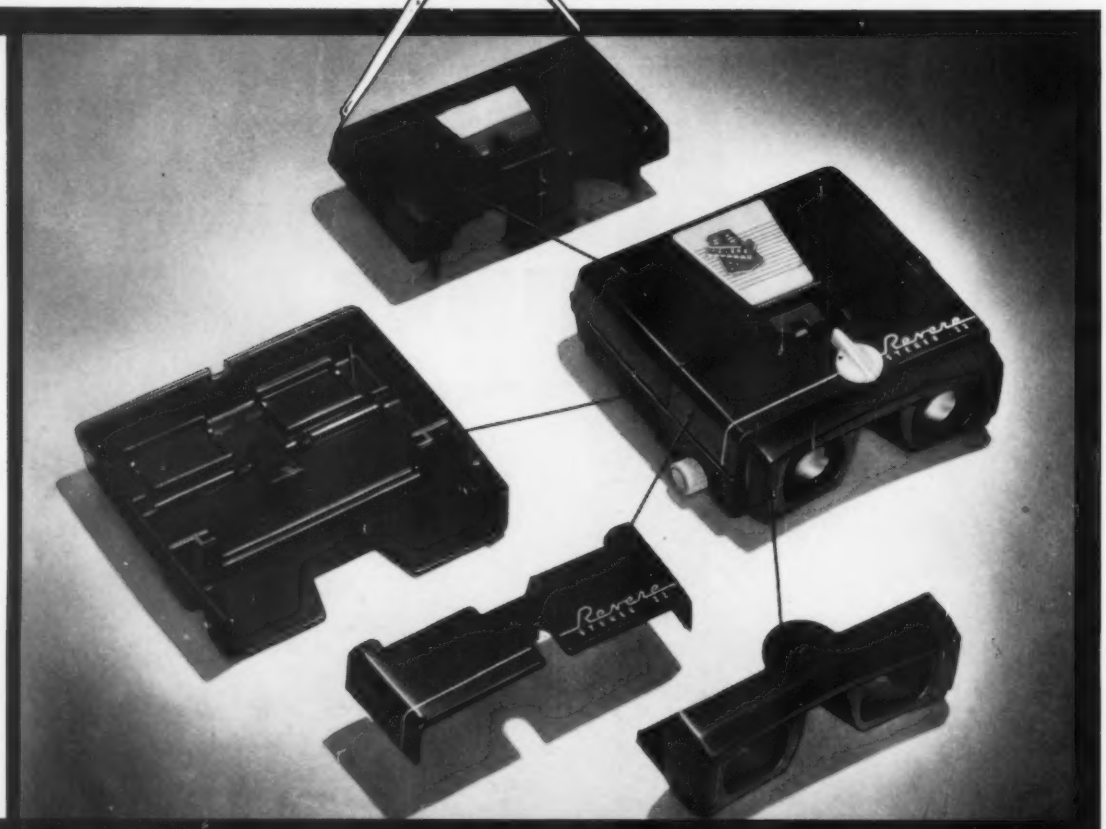
DE MATTIA MACHINE and TOOL CO

REVERE STEREO VIEWER . . .

# precision molded

## IN VOLUME PRODUCTION



by RICHARDSON

**SIX PLANTS**

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MELROSE PARK, ILL.

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INDIANAPOLIS, IND. TYLER, TEX.

This handsome plastic case for the Revere Stereo Viewer, produced by Richardson, required the molding of four intricate parts. Each part had to be held to close tolerances for easy assembly and good appearance. Special care was needed to prevent warpage, and also to produce a smooth lustrous surface. The Revere Camera Company was extremely pleased with the precision and beauty of the finished job.

Richardson specializes in plastics jobs of this type—jobs which require volume production of precision moldings of the highest quality. Why don't you consult Richardson on your difficult plastics jobs?

**Send for Bulletin, "Facts About Plastics"**

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THE *New* HIGH-IMPACT THERMOPLASTIC RESIN

***CYCOLAC has the very basic material properties needed in many electrical end-uses: Rugged toughness plus lightweight . . . low water absorption . . . high demolding (sag) temperature plus low brittle point . . . excellent electrical properties combined with greater dimensional stability. List at right is a small example of the many, many practical uses of CYCOLAC in your manufacturing.***

THE PERFECT RESIN FOR THE MANUFACTURE OF ELECTRICAL PRODUCTS SUCH AS THESE —

**COIL FORMS**
**CABLE AND WIRE CONNECTORS**
**INSULATOR BUSHINGS**
**SWITCH PARTS**
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**TERMINAL BOXES**
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**THERMOSTAT COVERS**

**PLUS a thousand-and-one other uses**

CYCOLAC — the one uniform resin that makes good products BETTER

Marbon®

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*Division of BORG-WARNER CORPORATION*

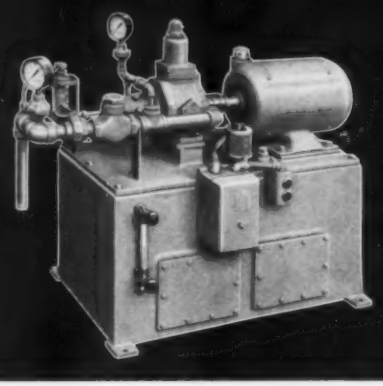
**GARY, INDIANA**

*MARBON . . . Precision Resins for Precision Made Products*

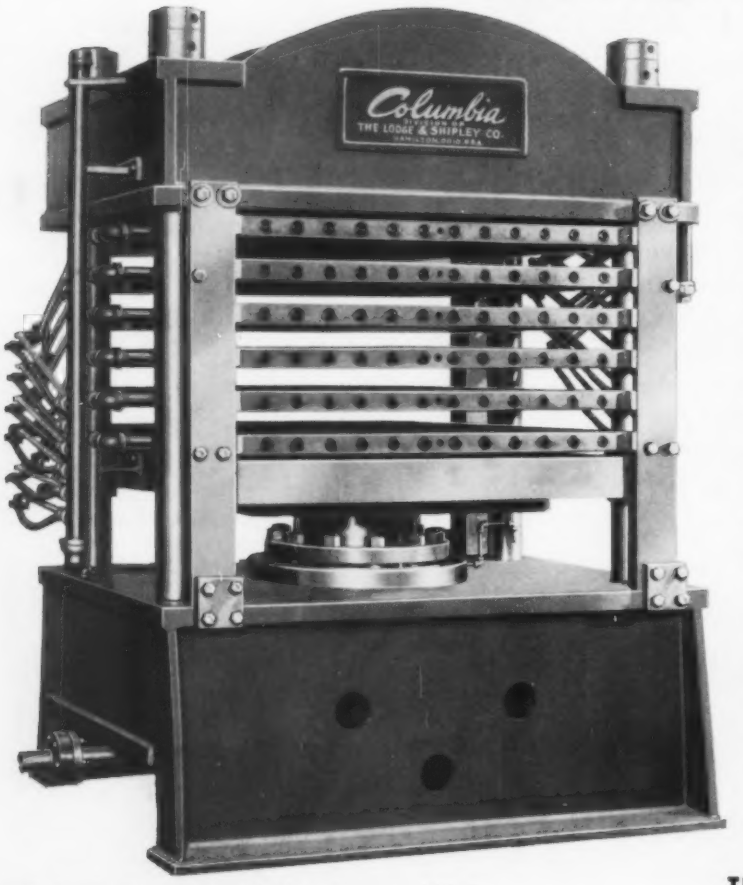
Columbia HYDRAULIC COMPRESSION MOLDING PRESS FEATURES

**UNITIZED PUMP**

A typical pumping unit combines pumping equipment, hydraulic reservoirs, gauges, valves, air filter and automatic vent in one trouble-free assembly.



# Columbia design simplifies compression molding of plastics




*Hydraulic Compression Molding Press — 300 T capacity, 36" x 36" platen*

Each Columbia Hydraulic Compression Molding Press is engineered for its particular job, then built of standard units to provide a "custom" press at lowest price.

For example, the typical hydraulic pumping unit featured here centralizes all the equipment . . . pumps, reservoir, valves, filter, vent . . . minimizing piping, original and maintenance costs. Pumping equipment varies with individual requirements, providing operational characteristics as needed.

Special features and optional equipment can be provided with any Columbia Hydraulic Compression Molding Press to present a money-saving solution of your molding problem.

*Get the complete story on exclusive Columbia molding press features. Write for new FREE Bulletin No. HP-4 and the name of your nearest distributor.*

**Columbia DIVISION**
**THE LODGE & SHIPLEY COMPANY**
**HAMILTON 12, OHIO, U.S.A.**

# the new light-as-a-cloud *Plastic Foam* is fabricated best on

**Thermatron**

HIGH FREQUENCY SEALING AND HEATING EQUIPMENT

The full potential of the new plastic foam is realized when this light fluffy material is *electronically welded* on the THERMATRON . . . and here's why:

**THERMATRON**

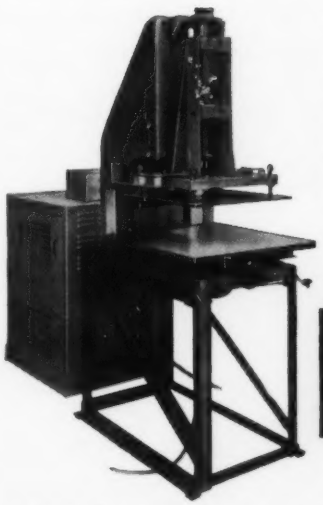
Shapes and tapers the material as it seals. Embosses it, too, if desired.

Produces a permanent bond that won't age or tear — and seals any shape or size.

Welds the foam to itself or to ordinary vinyl.

Does it all *easier*, faster, more economically, with smoother, more attractive seams.

Plastic foam is a *comer* because it lends itself to so many new or improved products, such as pillows, automobile cushions, buoyant toys, upholstered furniture, swim rings, insulated bags . . . It's even being used as the cushion pad on a nationally known strapless bra — THERMATRON welded, of course.



**FOAM RUBBER USERS** . . . Solve your fabricating problems with THERMATRON and Plastic Foam!

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# Vacuum-formed...Pressure-formed

## packaging

## with Celanese* Acetate Sheeting

A Craftsman Glass Cutter Display Card
for Sears Roebuck, by Merit Display, Paterson, N. J.

# make shoppers feel impulsive!

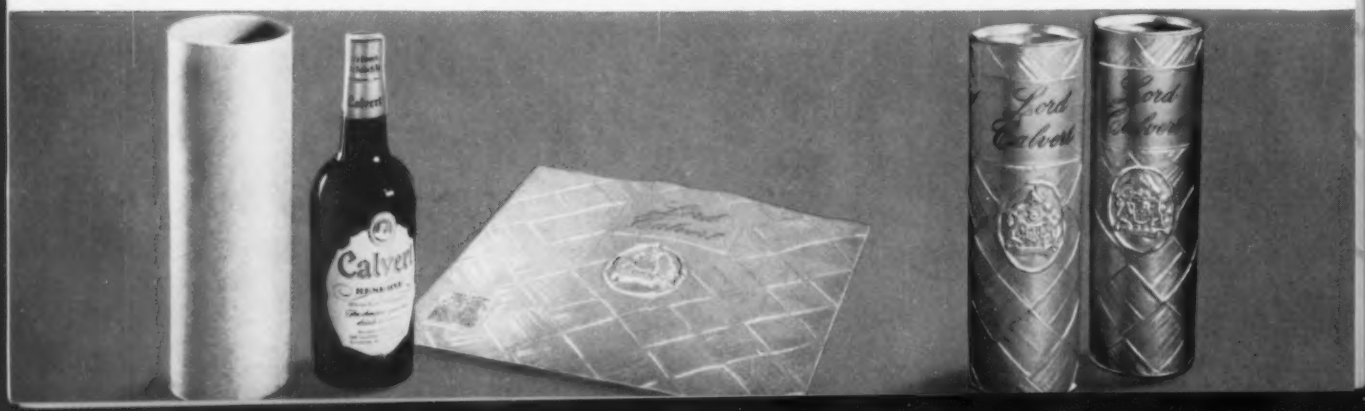
High visibility packaging to glamorize merchandise and stimulate impulse purchases . . . combination packaging that protects multiple parts from becoming lost . . . store displays to catch the eye of the shopper . . . these are the sales-sparking ideas possible with vacuum forming and Celanese Acetate Sheeting!

Best of all, vacuum forming is adaptable to either short or long runs. It's fast . . . it's economical . . . it's sure fire!

The Celanese Product Development Department can tell you what you want to know about probable costs, and put you in touch with fabricators who specialize in this rapidly expanding production method.

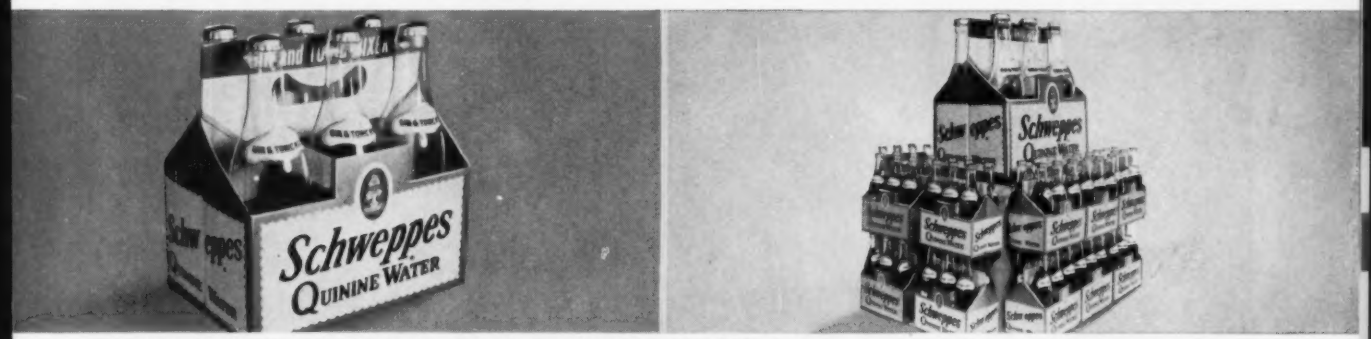
Celanese Corporation of America, Plastics Division, Dept. 101-D, 290 Ferry Street, Newark 5, N. J. Canadian affiliate, Canadian Chemical Company, Ltd., Montreal and Toronto.

Calvert Display Container, by King Plastic Products, College Point, L. I.

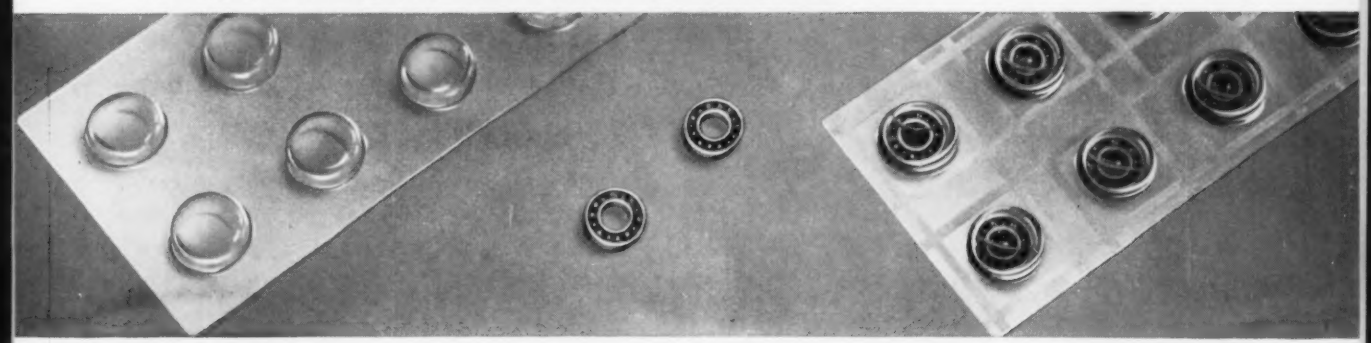


HY-PRO tap container, by William Crook Co., Watertown, Mass.

E-Z LaceloK by E-Z Buckle, Inc., New York, N. Y.




Store display for Schweppes, by Majestic Creations Inc., Woodside, L. I.



**The reproduction above illustrates a new concept in protective containers. Acetate is ideally suited to packaging bearings and other precision parts which require oil bath protection. It exhibits outstanding oil resistance characteristics—even for synthetic oils and greases. The transparency of the acetate provides a means for visual inspection at all times.**

**This tested packaging method permits contents to be individually sealed and opened separately . . . reduces pilferage. Special heat sealing machinery for this application has been developed by Plastic Industries, Montclair, N. J.**

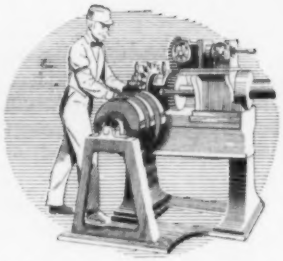
**Celanese Market Development Department has this packaging method under laboratory and field tests. If you are now packaging precision parts requiring protection against corrosion, Celanese will be glad to work with you in developing a formed container applicable to your needs.**

Have you tried Celanese polyethylene sheeting? More and more manufacturers are finding it easy to vacuum and pressure form. Development quantities are now available. Direct your inquiry to Market Development Department.

Celanese*

*Reg. U.S. Pat. Off. PLASTICS

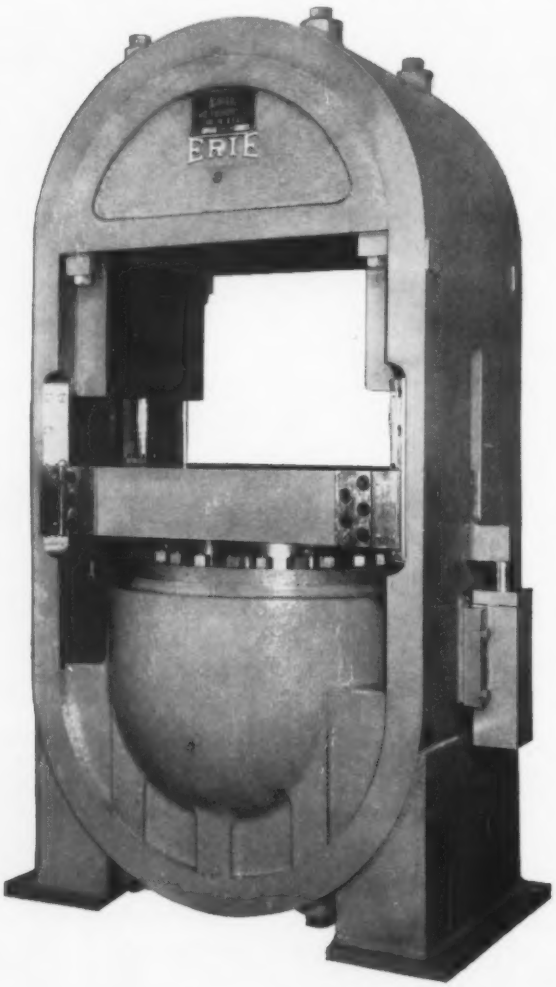
# In the good old days



**WHEN GRANDPA RAN THIS EXTRUDER**

WHEN Germany was the world's largest exporter of rubber goods . . . when South America was the largest exporter of crude rubber which was then called Para . . . . . when the first Malaya plantation yielded crude rubber

**ERIE FOUNDRY WAS A GREAT NAME IN COMPRESSION PRESSES**




## in today's plastic shop

**...when** low stress insures minimum deflection

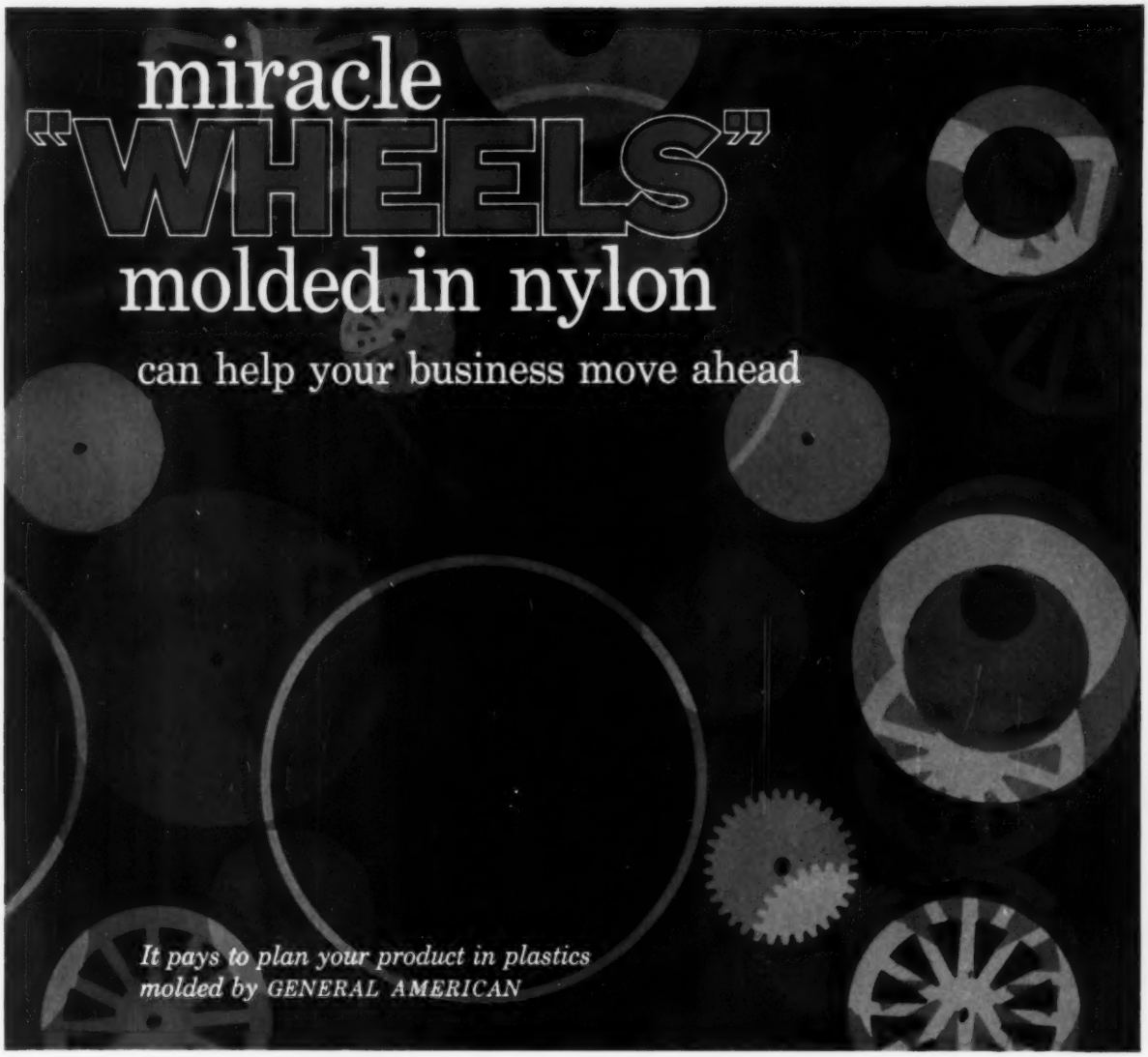
**...when** high pressures evenly applied to practically deflection-free (within .002 inches) platens guarantee thin flash lines

**...when** competitive bidding demands maximum service for minimum cost

**ERIE**

**is by far the greatest name in special precision compression presses**

IN OUR 60TH YEAR **ERIE FOUNDRY CO. ERIE, PA.**




"Wheels" are not always round: they can be square, geared, trapezoid, large or small—any shape at all. When molded in nylon, they'll be light in weight, long-wearing and strong .They'll withstand abrasion and deterioration. They'll be easy to clean and resistant to acids, alkalies, oils and grease—and, they'll give a distinct competitive advantage to the equipment maker whose products offer these benefits.

If you now use other materials, you'll find you probably can do a faster, better job in plastics by taking advantage of General American's unduplicated production facilities. Ask for further information.

PLASTICS DIVISION
GENERAL AMERICAN
TRADE MARK

PLASTICS DIVISION
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street · Chicago 90, Illinois

Facilities unmatched anywhere: *injection, compression, extruding and vacuum forming, reinforced plastics, painting and assembling.*

***Another new development using***

# B. F. Goodrich Chemical *raw materials*

*Nik-Guards made by Radiator Specialty Company, Charlotte, North Carolina. B. F. Goodrich Chemical Company supplies the Hycar rubber only.*

## GAS NOZZLE GUARD SAVES FENDERS

FENDERS often get scarred and scratched while the car is standing still—at the gas station. A hurried or careless attendant does the job, wielding a metal nozzle on his gas pump hose. But thanks to Hycar American rubber, nicks and scratches from this source are on their way out. A North Carolina manufacturer has come up with the answer by molding the versatile, gasoline-resistant Hycar into a protective nozzle shield.

The Hycar is molded to fit snugly around nozzle and nozzle handle so that nothing hard or sharp comes in contact with the car finish. The molded piece, called Nik-Guard, retains its strength, flexibility, and tight fit for years . . . because of Hycar's exceptional resistance to gasoline, abrasion, and extremes of temperature.

Hycar, molded to close tolerances, is used in the petroleum industry all the way from oil well to your car . . . in drilling, pumping, refining, storage, and shipping of petroleum products. Throughout industry, Hycar is making notable improvements in products and processes. To find out how it may fit your own needs, please write Dept. CF-2, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

**B. F. Goodrich Chemical Company**
**A Division of The B. F. Goodrich Company**

**Hycar**
Reg. U.S. Pat. Off.
*American Rubber*

**GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors**

# Many tough jobs go to U.S. Gasket...and Fellows molding machines help *"make them pay!"*

Fellows Injection Molding Machines offer rapid-cycling fully automatic production along with maximum flexibility.

**EXTRA THIN WALLS** and critical dimensions! Intricate, multi-hole shapes with accumulative close tolerances! Metal inserts with a coefficient of expansion 10:1 greater than the plastic! Pieces in Nylon, Kel-F, PVC, Fluorothene and all the polyethylenes that can present molding problems! Because the United States Gasket Company, Camden, New Jersey are specialists in molding the really difficult pieces...they have built production capacity EXCLUSIVELY around modified Fellows Injection Molding Machines.

Their 3 and 8 ounce Fellows Machines provide the high degree of reliability and adaptability necessary to meet rigid production schedules. They have extremely sensitive heat control...stepped-up wattage, cylinder pressure and injection rate...they provide excellent "homogenization" of material which is vital when working in the more difficult plastics. Whenever yours is an Engineered Plastics or Speed Molding Problem...the Plastics Machine Specialist at any Fellows Office is at your service!

**Fellows**
**injection molding equipment**

THE FELLOWS GEAR SHAPER COMPANY, Plastics Machine Division, Head Office and Export Department, Springfield, Vermont
Branch Offices: 319 Fisher Bldg., Detroit 2 • 5835 West North Ave., Chicago 39 • 2206 Empire State Bldg., New York 1
6214 West Manchester Ave., Los Angeles 45.

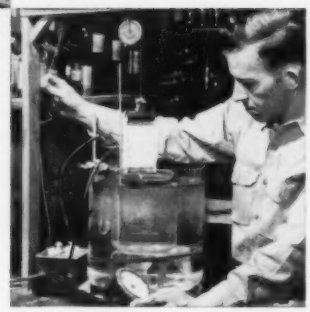
# FERRO QUALITY CHECKS

bring a new "dimension" to

Fiber-Glass Reinforcements

2

1



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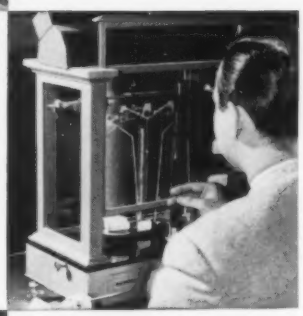

5

6

## THE STORY OF A REVOLUTION IN QUALITY CONTROL

Users of *Fiber Glass Reinforcing Mats* know the grief that results when the mat "goes off standard" in any way. Sometimes the mat doesn't wet out satisfactorily —and costs climb while production drops. Or weak spots may develop in the finished product. Or again, in translucent materials, variations in weight may show up as variations in translucency.

Here at Ferro we've done something about this—not just in meeting each customer's requirements broadly, but in assuring that *every roll* of mat shipped to him conforms to his "specs".

As may be guessed from the pictures here, we carefully check our production for (1) *Weight Uniformity* . . . (2) *Dry Tensile Strength* . . . (3) *Wet Tensile Strength* . . . and (4 & 5) *Binder Content*. These tests, plus close visual inspection of the mat, go on *continuously* and records are kept on every roll produced.

Periodically, we also check (6) the flexural, compressive and tensile strengths of finished laminates made from our mat. When these are "right", we *know* we have a happy customer.

And wouldn't *you, too*, be happier with the roll-by-roll uniformity of *Uniformat* Reinforcements?

FERRO

## FERRO "UNIFORMAT"

*Fiber Glass Reinforcements*

FERRO CORPORATION • 200 WOODYCREST AVENUE • NASHVILLE 11, TENN.

Installed in:
Argentina
Australia
Austria
Belgium
Belg. Congo
Brazil
Bulgaria
Canada
Chile
Denmark
Egypt
Finland
France
Gr. Britain
Greece
Holland
India
Indonesia
Iran
Irland
Iceland
Italy
Japan
Mexico
Norway
Pakistan
Poland
Portugal
Sweden
Switzerland
Spain
South-Africa
Turkey
Uruguay
U. S. A.
Venezuela

*The world-wide plastics industry points to*

**Reifenhäuser-Extruders**

U.S. Representative for sales and service:
H. H. HEINRICH CO
111 8th Ave NEW YORK 11 N.Y.

**A·Reifenhäuser**
MASCHINENBAU
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BOPP

# Find the Newest Answer to

# CORROSION CONTROL

## in this 20-page KEL-F® Dispersions Manual

Learn how you can get the advantages of KEL-F fluorocarbon plastic: corrosion and heat resistance, anti-adhesion, abrasive resistance, excellent electrical properties, moisture resistance *in a dispersion coating, for application by spraying, dipping or spreading*

® Registered trademark of The M. W. Kellogg Company's fluorocarbon polymers

KELLOGG

**THE M. W. KELLOGG COMPANY**
Chemical Manufacturing Division
P. O. Box 469, Jersey City 3, N. J.

Please send me my copy of the new Kellogg Manual, "Application Techniques for KEL-F® Fluorocarbon Polymer Dispersions."

Name _____
Title _____
Company _____
Address _____
City _____ State _____

I am interested in Dispersion Coating Applications for:

- ☐ trailer tanks
- ☐ tankcars
- ☐ storage tanks
- ☐ pipe lines
- ☐ pumps
- ☐ mixers
- ☐ valves
- ☐ flowmeters
- ☐ reactors
- ☐ shipping containers
- ☐ waste neutralizers
- ☐ agitators
- ☐ calendering rolls
- ☐ forming dies
- ☐ guide rolls
- ☐ mattress molds
- ☐ tire molds
- ☐ ribbon blenders
- ☐ cone blenders
- ☐ hoppers
- ☐ casting molds
- ☐ coated glass tape
- ☐ miniaturized stators
- ☐ distribution transformers
- ☐ miniaturized relays

Other applications (please list) _____

# speaking of operations...

Let us tell you about *our* operation—a small section of which is shown above. It's the world's largest operation of a complex inorganic chemical process—the manufacture of TITANOX white pigments at Sayreville, N. J.

Bigness is essential in our business for two reasons. First, to keep ahead of your increasing demand for titanium dioxide white pigments in new and established uses. Second, to maintain your preference for TITANOX white pigments—a preference created by TITANOX quality, service and uniformity.

These are two reasons why more TITANOX titanium pigments are sold than all other brands combined. And they're the reasons why so many different industries have discovered that TITANOX is *first choice in white pigments.* Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; Atlanta 2; Boston 6; Chicago 3; Cleveland 15; Houston 2; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 14, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1.

®**TITANOX**

*the brightest name in pigments*

**TITANIUM PIGMENT CORPORATION**

*Subsidiary of* NATIONAL LEAD COMPANY

# For high impact Styrene sheet extrusion

NRM

*Offers the*

## PLASTICS INDUSTRY

*a Complete New*

# "PACKAGED" INSTALLATION

*with* **HIGH PERFORMANCE...LOW MAINTENANCE...EASY OPERATION**

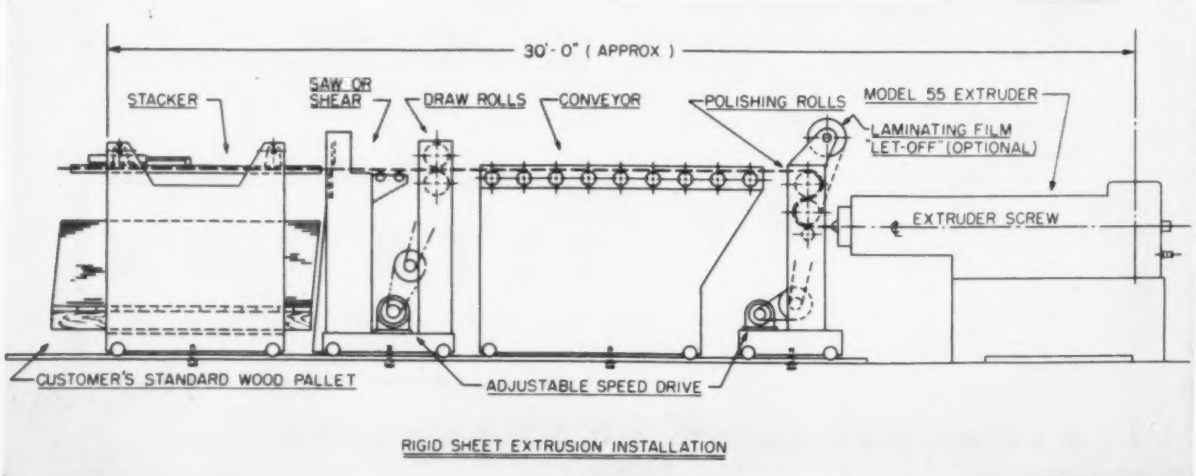
NRM has long recognized the need of the plastics industry for self-contained units which would include every piece of equipment required for production of top quality rigid sheet extrusions. We also recognized that, to be practical, such units could not be sprawling and cumbersome. Compact, integral and space-saving design was a *must.*

Some of the problems facing development of such "packaged" units were how to achieve this compactness at no sacrifice in extrusions quality, and how to make their production rate high enough to justify initial cost, and assure good profit from continued operation.

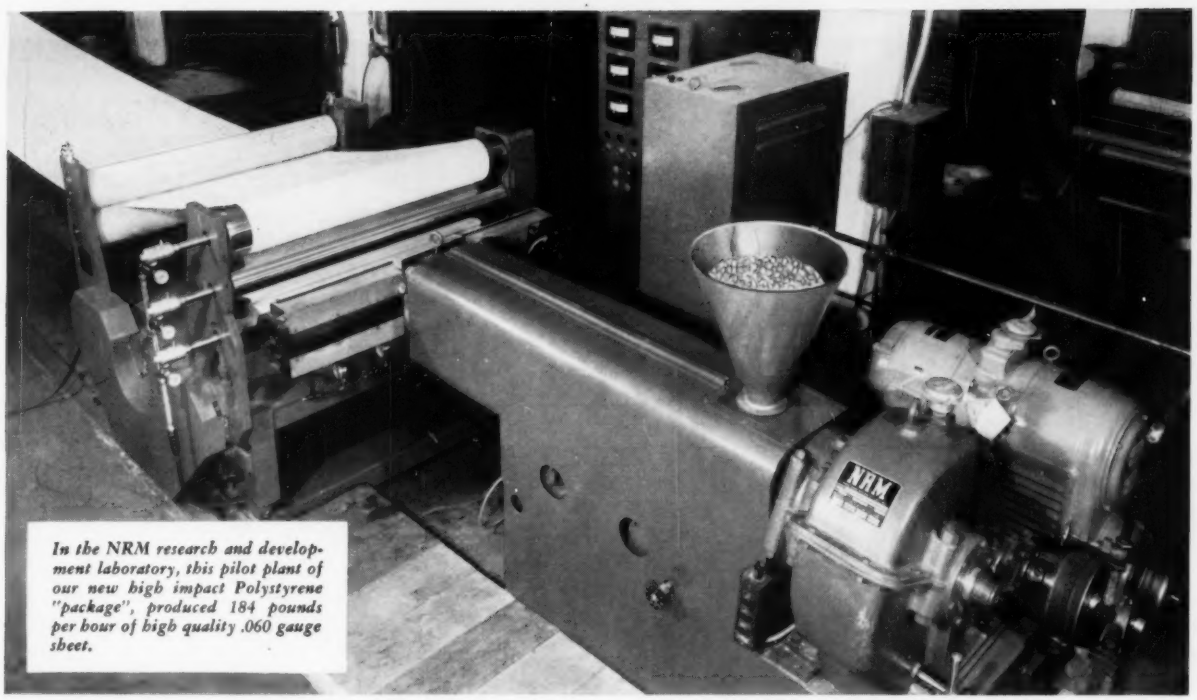
Our 20:1 $L_e/D$ ratio Extruder gave us the optimum answer to both these problems. In response to the plastics industry's needs for higher production capacities from extruders, we developed the 20:1 ratio, working closely with the plastics industry to perfect it. Producing up to 50% *more* extrusion pounds per hour than conventional machines of the same size, we saw that it would not only make possible, but would greatly simplify, development of really *"packaged"* extrusion plants. The rest of the work — designing dies and accessories to take fullest advantage of the high production capacity of the Extruder — was soon accomplished . . . with even closer co-operation from both suppliers and processors of the plastics industry.

After much intensive research and development, during which the 20:1 ratio Extruder and its accessories virtually "came of age" together, NRM now makes available the complete plant you've needed for better, more profitable production of high impact Styrene sheet. The entire installation takes only 6′ by 30′ of floor space, approximately, but the drawing below will help you appreciate this compactness better than words.

2371




RIGID SHEET EXTRUSION INSTALLATION




*In the NRM research and development laboratory, this pilot plant of our new high impact Polystyrene "package", produced 184 pounds per hour of high quality .060 gauge sheet.*

**THE EXTRUDER** — Our 3½" Electrically Heated Model 55 with 20:1 $L_e/D$ ratio is the heart of the package. Where devolatilization is required, it is furnished vented, and for extruding such materials as Styron 475, Dow's Dulmage type torpedo feed screws are also available. In addition to the 20:1 feature, the Model 55 has all the traditional NRM design and engineering advantages the plastics industry has so long relied upon for simpler operation, less maintenance and therefore more *profitable* extrusion.

Sheeting dies for the "package" are of the manifold type, carefully engineered to suit the Extruder, and designed expressly for Polystyrene extrusion. Dies are available standard for sheet widths from 24" to 48". Greater widths available on request. Dies are furnished with all controls and control instruments.

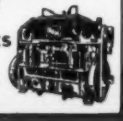
## "BIG THINGS" IN EQUIPMENT FOR BETTER PLASTICS PRODUCTION *Keep happening AT NRM*

In making available this first *complete* unit for high impact Styrene sheet production, NRM recognizes the importance of the close interchange of ideas we have had with the plastics industry all along the way. We know, too, that this close cooperation between the manufacturers of plastics, and the manufacturer of machines for processing them, helps assure the industry of the most *practical* answers to their machine requirements. With their continued cooperation, we are already moving ahead to give you this "packaged" unit for sheet extrusion of Acrylic, Krylastic, Plio-Tuf, Butyrate and others. We can't tell here all you'd like to know about our Styrene "package," but visit us at the NRM research and development laboratory and we'll be happy to give you complete details *and a demonstration.*

2371

**THE ACCESSORIES** — From polishing roll to stacker, all accessories are especially designed for proper finishing and handling of Styrene sheet . . . all are track-mounted for quick accessibility. The self-powered polishing roll has large diameter, super-finished polishing rolls with speed control, and heat control of the roll faces. The conveyor features multi-roll support to keep sheet level and true as it is carried to the draw roll. The draw roll is specially designed to maintain proper tension for rigid sheet. The cutting unit is mounted integral with the draw rolls and has a variable-speed power shear. The stacker loads cut sheet properly on standard pallets for subsequent handling operations.

ENCOURAGE OUR YOUTH To CONSIDER The OPPORTUNITIES In ENGINEERING and SCIENCE



# NRM

## NATIONAL RUBBER MACHINERY CO.

General Offices and Engineering Laboratories, 47 West Exchange St., Akron 8, Ohio — HEmlock 4-2131
Eastern Plant: 384 Getty Ave., Clifton, N. J. — Prescott 7-7500
West: S. M. Kipp, Box 441, Pasadena 18, Calif. — Sycamore 4-2110
Export: Omni Products Corporation, 460 Fourth Ave., New York, N. Y. — Lexington 2-1320

**Get "20:1 Quality and Performance" with NRM 20:1 $L_e/D$ Extruders**

Monsanto Plasticizer News

# Flame Retardent... Non-Toxic Good Low Temperature Flex

# SANTICIZER 141

**FLAME RETARDENT**

50 p.h.r. DOP

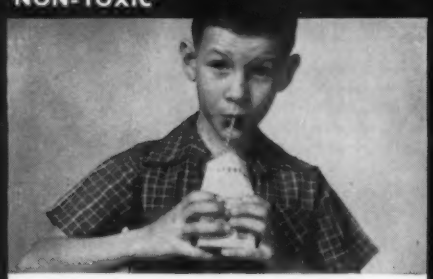
35 p.h.r. DOP
15 p.h.r. Santicizer 141

**S.P.I. FLAMMABILITY TEST** on 2 films shows superior flame retardance of vinyl containing Santicizer 141 plasticizer. Enables vinyl garment makers to comply with the 1954 Flammable Fabrics Act.

**IN ADDITION**—Santicizer 141 offers the same low-temperature flex as DOP, *plus* improved light stability, superior stain and oil resistance, and faster fusion and processing characteristics.

*Santicizer: Reg. U.S. Pat. Off.*

**NON-TOXIC**



**SANTICIZER 141** has been fully approved by the Bureau of Animal Industry as a nontoxic plasticizer for use in vinyl products such as food containers, wrapping films, beverage tubing, packaging materials, etc., which are intended for contact with food items.

**LOW TEMPERATURE FLEX IS EQUIVALENT TO DOP**

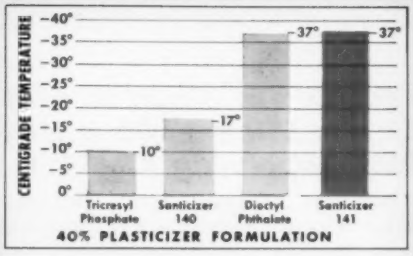



**CHART SHOWS** the flexibility Santicizer 141 imparts to food wrapping, paper coating, sheeting and film.

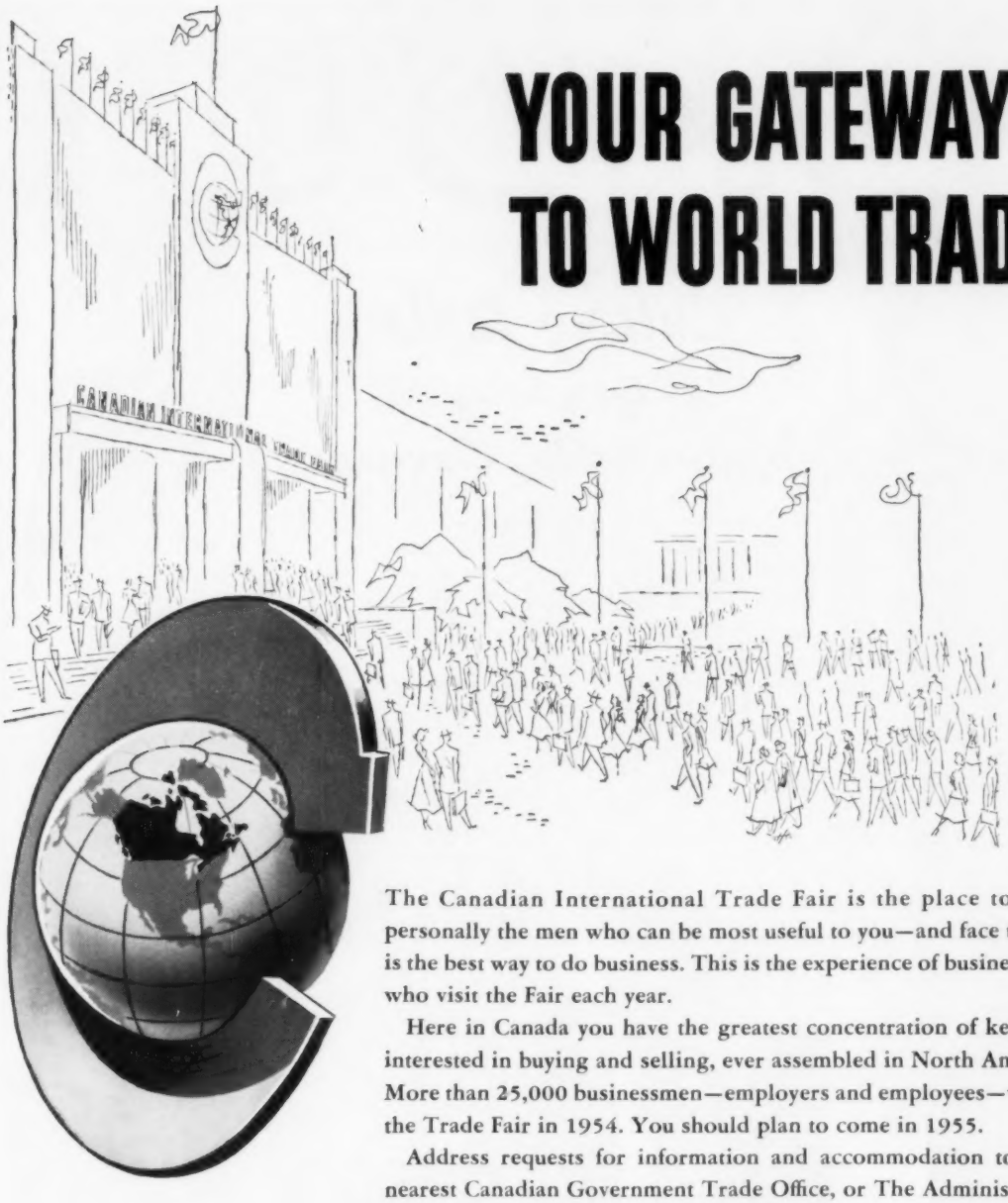
MONSANTO

SERVING INDUSTRY WHICH SERVES MANKIND

**FAST DELIVERY.** For delivery when you are in need, Monsanto has bulk shipping stations located in strategic cities from coast to coast.

**FOR MORE FACTS** on the Santicizer 141, write for technical Bulletin: Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478-R-2, St. Louis, Missouri.

# YOUR GATEWAY TO WORLD TRADE



The Canadian International Trade Fair is the place to meet personally the men who can be most useful to you—and face to face is the best way to do business. This is the experience of businessmen who visit the Fair each year.

Here in Canada you have the greatest concentration of key men interested in buying and selling, ever assembled in North America. More than 25,000 businessmen—employers and employees—visited the Trade Fair in 1954. You should plan to come in 1955.

Address requests for information and accommodation to your nearest Canadian Government Trade Office, or The Administrator, Canadian International Trade Fair, Exhibition Park, Toronto, Canada.

*8th Annual*

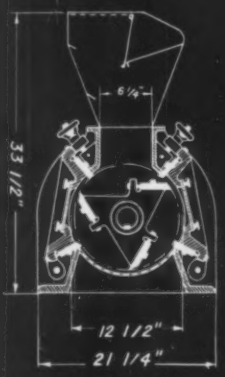
## CANADIAN International TRADE FAIR

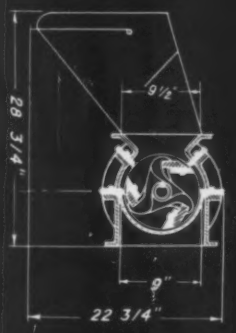
**TORONTO CANADA MAY 30th TO JUNE 10th 1955**

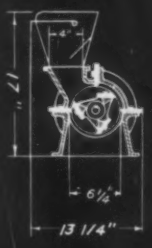
**YOUR GATEWAY TO WORLD TRADE**

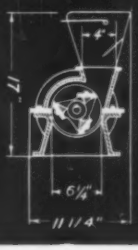
**OPERATED BY THE GOVERNMENT OF CANADA TO PROMOTE YOUR BUSINESS**

# CONDUX



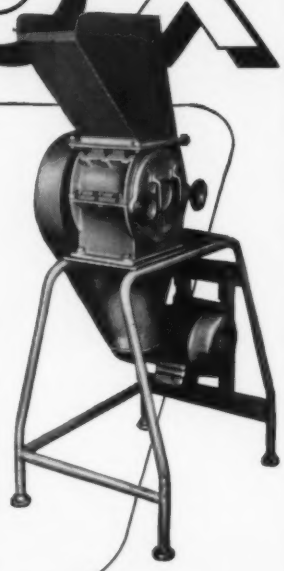




## *Cutting Mills*

### *For Granulating All Injection Molding Compounds*

- Quick disassembling and easy cleaning owing to perfect design and very simple construction.
- Uncomplicated exchange of screen plates.
- Cutting blades easily accessible for adjustment.
- Feeding of cords and skeins thru infinitely variable feed rolls.
- Cooling down or carrying away of hot granulated materials or substances sensitive to heat by means of built in pneumatic conveying.



**CONDUX-WERK**

Herbert A. Merges KG

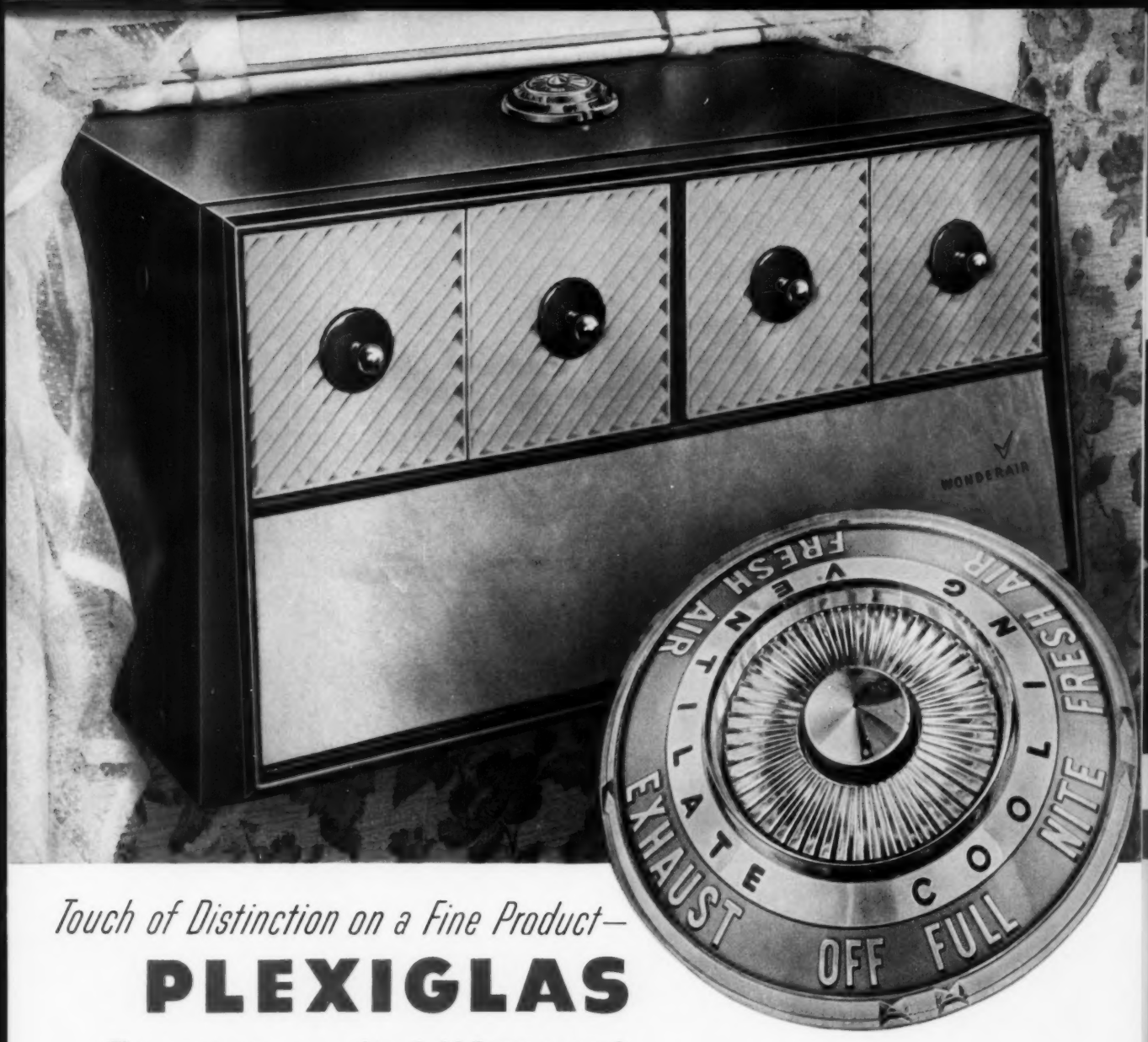
**WOLFGANG BEI HANAU 8**

Germany

**We are awaiting you at the Technical Fair in Hannover in the time from 24 April to 3 May 1955 in Hall 4, Stand 809**

***and***

**at the Chemical Engineering Exhibition and Congress in Frankfurt/M in the time from 14 to 22 May 1955 in Hall 2, Stand D 27-32, E 27-32**




*Touch of Distinction on a Fine Product—*

# PLEXIGLAS

The moment customers see this colorful PLEXIGLAS control knob, a favorable impression is created. The knob does more than operate the air conditioner. Molded of PLEXIGLAS, it adds sales appeal.

Parts molded of PLEXIGLAS have a rich, brilliant appearance that stays fresh and bright for years. That is why this acrylic plastic, its durability proved by years of use for enclosures on aircraft, is used by manufacturers in other fields for decorative and functional parts such as trademarks, nameplates, dials, lenses, and instrument panels.

PLEXIGLAS can add a final touch of sales power to *your* product. We will be glad to tell you how.

**PLEXIGLAS**
molding powder product design

This new brochure contains detailed information on the design of molded PLEXIGLAS parts. We will forward it promptly on request.

**Please send me a copy of "Molding Powder Product Design".**

Name.....

Firm.....

Address.....

City.....Zone....State.....

CHEMICALS FOR INDUSTRY

**ROHM & HAAS COMPANY**

**WASHINGTON SQUARE, PHILADELPHIA 5, PA.**

*Representatives in principal foreign countries*

*PLEXIGLAS is a trademark, Reg. U.S. Pat. Off. and other principal countries in the Western Hemisphere.*

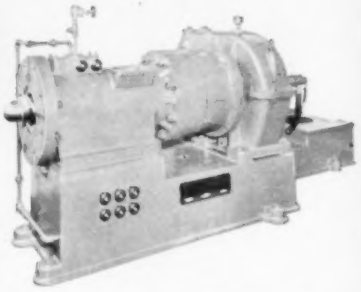
Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.*

# RUBBER and PLASTIC *machinery*

## Builders of National Erie Line

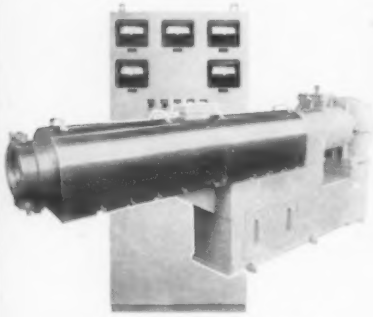
The combination of H & K and Aetna-Standard offers a complete service to the rubber and plastic industries. Builders of the National Erie line of machinery, H & K and Aetna make all types of equipment. Sales and engineering are the responsibility of Hale & Kullgren, Akron, Ohio. Aetna manufactures the equipment in their Warren, Ohio, plant.

### EXTRUDERS and STRAINERS FOR RUBBER



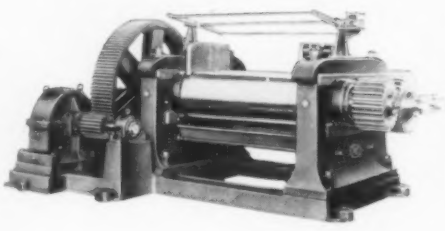
Standard sizes 2½ through 12". Illustrated—8" size for tire treads.

### EXTRUDERS FOR PLASTICS



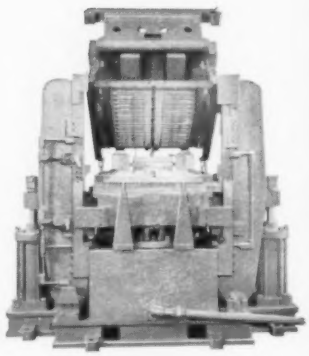
Sizes: 1½", 2½", 3½", 4½", 6", 8" and 10". Illustrated—4½" with devolatilizing section and heat control panel.

### MILLS



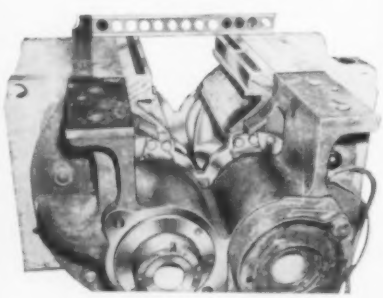
Sizes from 6" x 12" through 26" x 84". Automatic or Standard types.

### PRESSES



Tilting Head (illustrated); Plate Side and Rod Type with all standard platen sizes.

### BANBURY REPAIR SERVICE



Standard Parts, Swap Service or Rebuilding Service.

### CUBERS

Heavy-Duty 4-Ton, cuts one to three million pounds before resharpening.

### SIMPLEX DOORS

Any size from 12 inches to 12 feet, pressures up to 400 pounds, also for vacuum. Designs for special applications.

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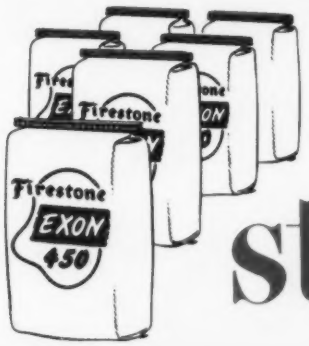
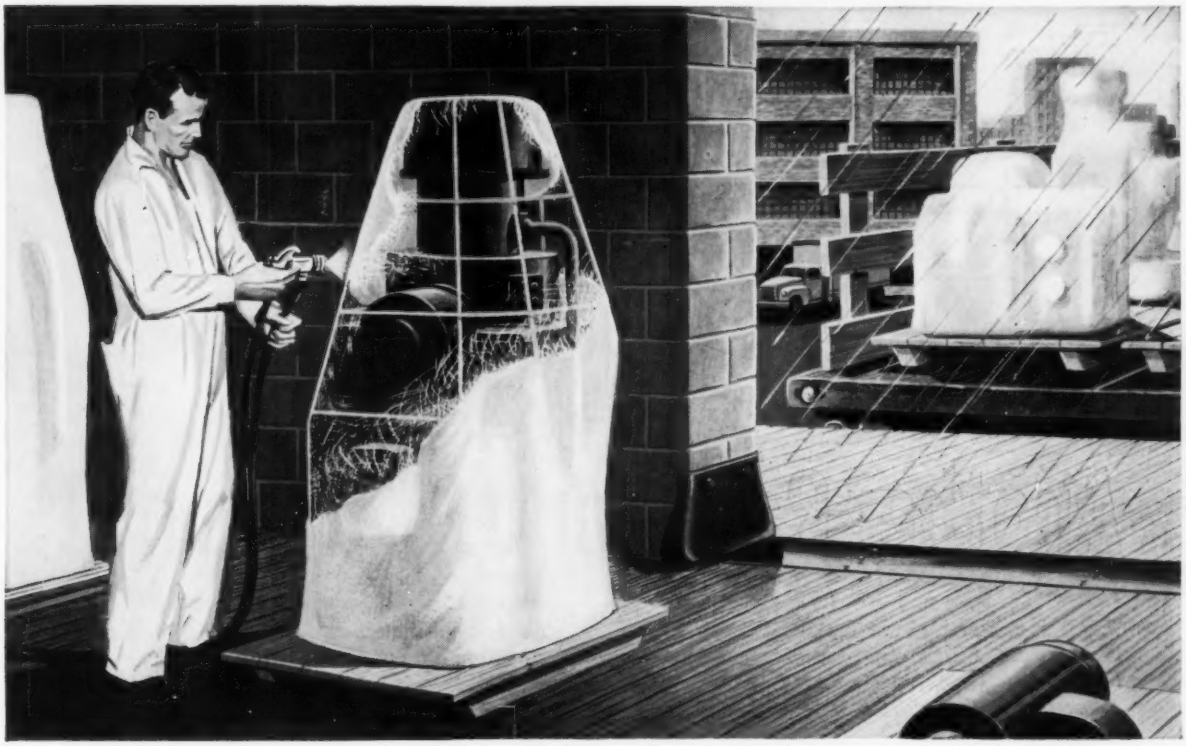
EXON: each resin engineered for a specific problem




# EXON 450

specifically for

# strip coatings



**Using one resin instead of two spells economy** for compounders of strippable vinyl coatings. New EXON 450 makes this possible. It simplifies compounding techniques because this one resin provides good solubility, film tensile strength and durability in the formulations based on it.

**To assure product protection** from dust, dirt, moisture, grease and weathering —both industry and government* are making extensive use of spray-applied vinyl wrappings made with EXON 450.

**Easy to use, easy to remove!** Strip coatings made from EXON 450 can be spray-applied from various solvent combinations and require no further maintenance. When the coating is stripped or peeled off, the product is left clean and ready for immediate use.

For complete information or technical service on the ever-growing line of EXON resins, call or write:

Firestone

EXON

*EXON 450 meets Government Specification MIL-B-12121

**CHEMICAL SALES DIVISION**
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DIVISION OF FIRESTONE TIRE & RUBBER CO.

Engineered and fabricated by Regal Plastic Company, Kansas City, Missouri.

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The Breuer Electric Manufacturing Company *had* the solution. All they needed was something to *hold* it in!

Something that would be unaffected by the shampoos and other chemical solutions used with their "Tornado" floor machines . . .

- . . . that would be easy to fabricate and relatively inexpensive to produce.
- . . . that would contribute to the modern appearance and efficiency of the machine.
- . . . that *would not break or leak* when subjected to the rough use this powerful, versatile worker had to take.

***All they needed was U. S. Royalite!***

When they switched to U. S. Royalite for their solution tanks, they found it far less costly to fabricate than the formed metal previously used. And it *required no expensive finishing operations.* (The two halves are draw-formed separately, reinforced with bosses and flanges for threaded attachments, and liquid welded together. A transparent plastic inset shows fluid level.)

And though extremely light, this U. S. Royalite plastic tank is so rugged that it's brought *complete customer satisfaction in three years of grueling service.*

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# LESTER scores again for CANADIAN GENERAL ELECTRIC COMPANY LTD.

"For excellence of molding and attractiveness" —this White Owl Cigar Humidor won an award of merit for Canadian General Electric Company Limited, Cobourg, Ontario, in the Display Section, "Canadian Plastics" Achievements Award Competition 1954. It was molded in Lustrex Polystyrene on an 8 ounce Lester! In 1953 the container won a Bronze Award in the Packaging Association of Canada, Design Competition.

Mr. H. A. Gadd, Manager, Manufacturing and Engineering Service, added these remarks to the success story of Lesters at Canadian General Electric Company Limited: "From our Lesters we get...Ease of set-up, fast cycles, improved plasticizing by the internally heated cylinder, positive protection for molds at final closing point and the prompt manufacturer's service on the equipment."

Lester machines offer many profit making advantages to injection molders. Our representatives will be pleased to give you the details.

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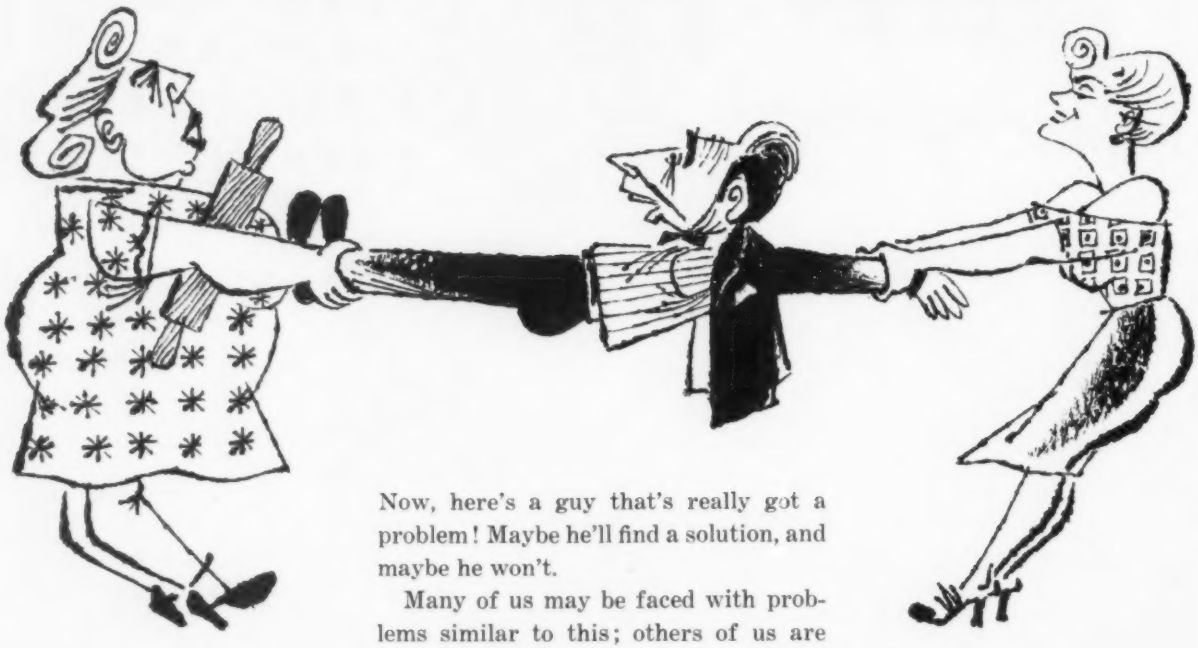
# 'Tween the Devil and those Blue, Blue Eyes!



Now, here's a guy that's really got a problem! Maybe he'll find a solution, and maybe he won't.

Many of us may be faced with problems similar to this; others of us are not so fortunate and only have business problems. That's where Boonton steps into the picture. We can't pitch in on your personal problems, but when it comes to plastics, that's where we shine.

Boonton will help you with 'most any problem concerning injection or compression molded plastics . . . and we'll help you with the proper selection of materials, with the best design for your product, and with getting a little more for a little less cost. You will welcome the countless other extra courtesies and services that are part and parcel of having Boonton mold your product. Literally hundreds of customers who order and re-order time after time attest to the fact that "fine molded plastics" and "Boonton" are two terms that always go together.

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Ford's new V-8s offer substantial power increase, "Trigger-Torque" performance, fashion interiors

Ford for '55 is a mechanized marvel. But today it takes more than a fine engine to power a sale. It takes styling—outside and inside.

That is why Ford's new inside story is one of captivating color and texture—tribute to fabrics and coatings exactingly chosen and tested. Vinyl-coated seat tops and trim demanded one type of fabric, headlinings quite another. Arm rests and door panels offered individual backing problems. We are proud that Wellington Sears fabric diversity—ranging from heavy-duty sateens, drills and sheetings to resilient knit backings, smooth spun rayons, and our unique, supple "Lantuck"® non-woven fabric—helped put Ford on the road.

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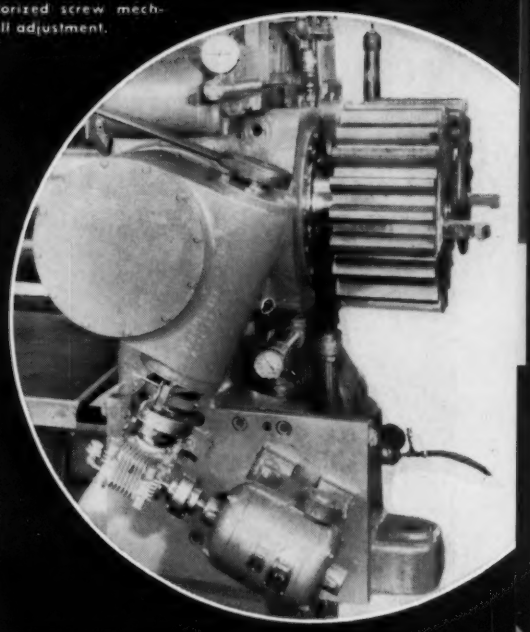
24" x 60" Phenolic Mill with individual bull gear drive for each roll, using one constant speed motor and one variable speed motor for main drive.



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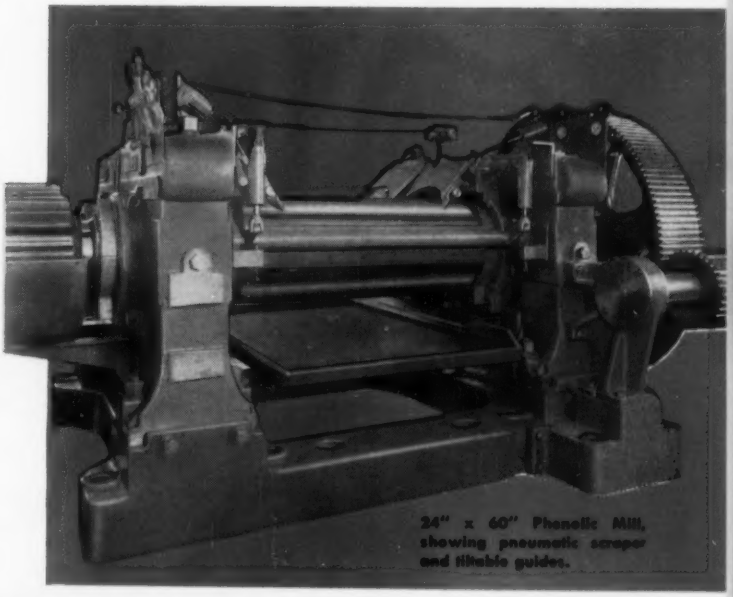
Why not call us in on your next mill installation? There'll be no obligation on your part.



24" x 60" Phenolic Mill, showing pneumatic scraper and tiltable guides.

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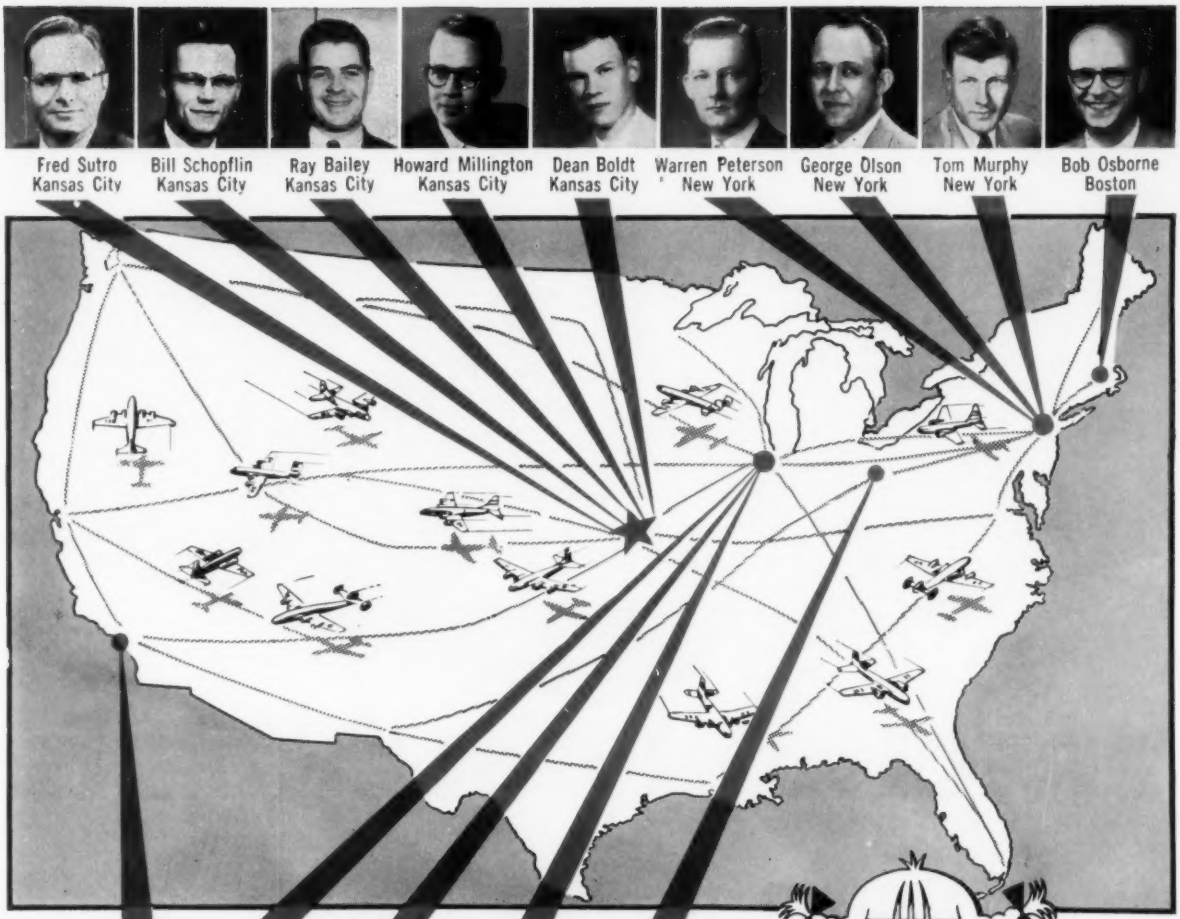
# These men have one job: To Serve You!



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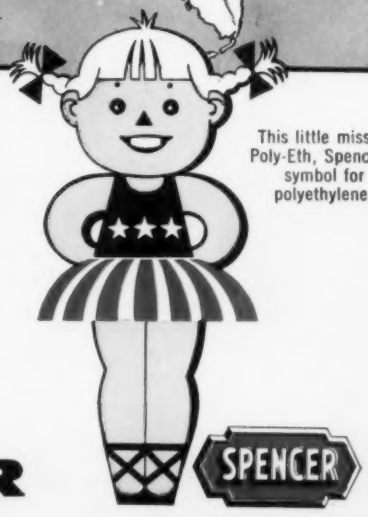


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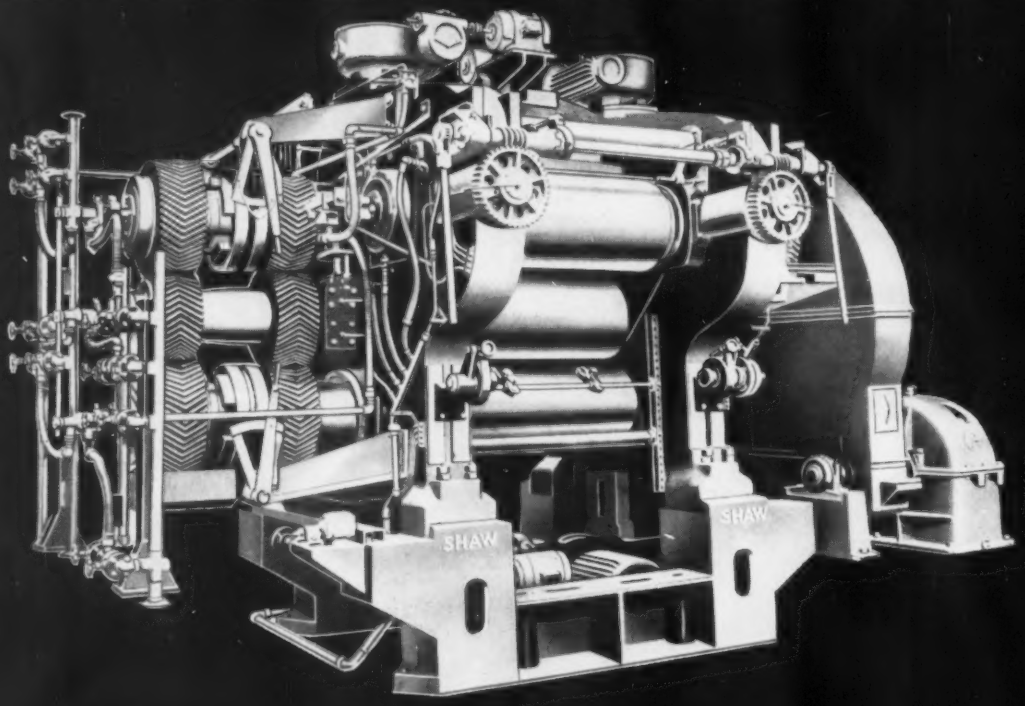


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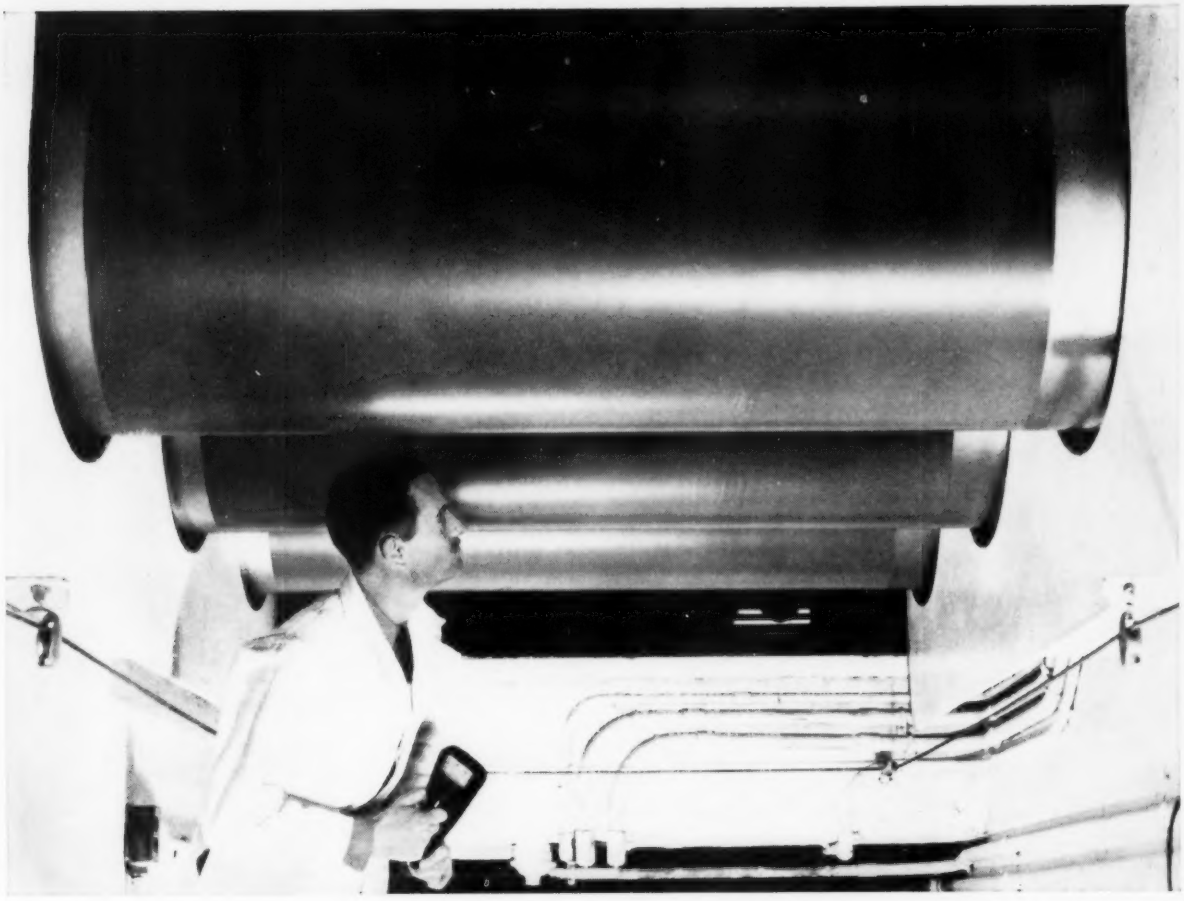

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**HERCOFLEX®** VINYL PLASTICIZERS
- **150** (di-n-octyl, decyl phthalate)
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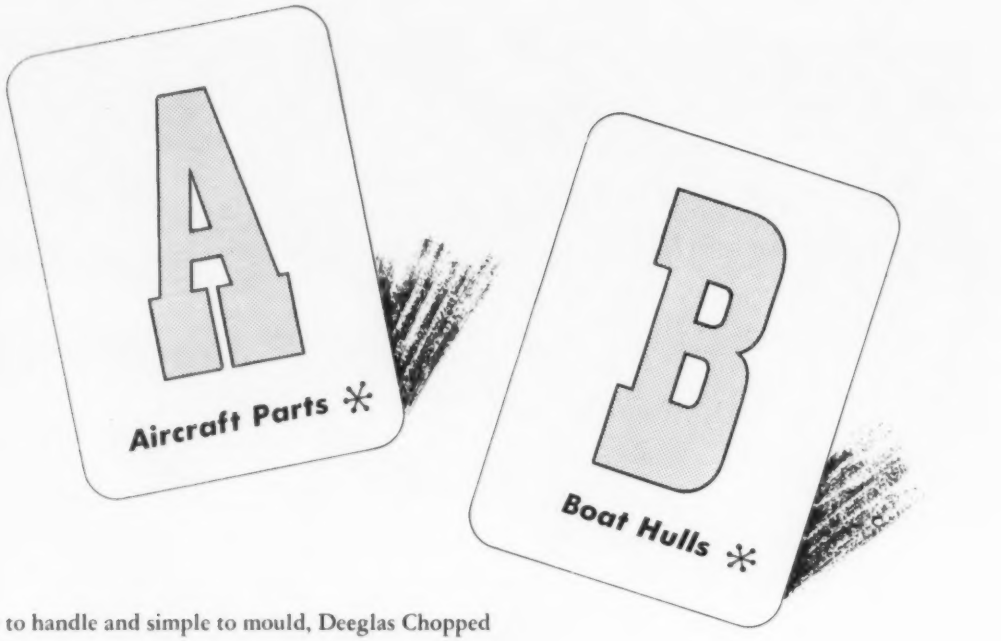


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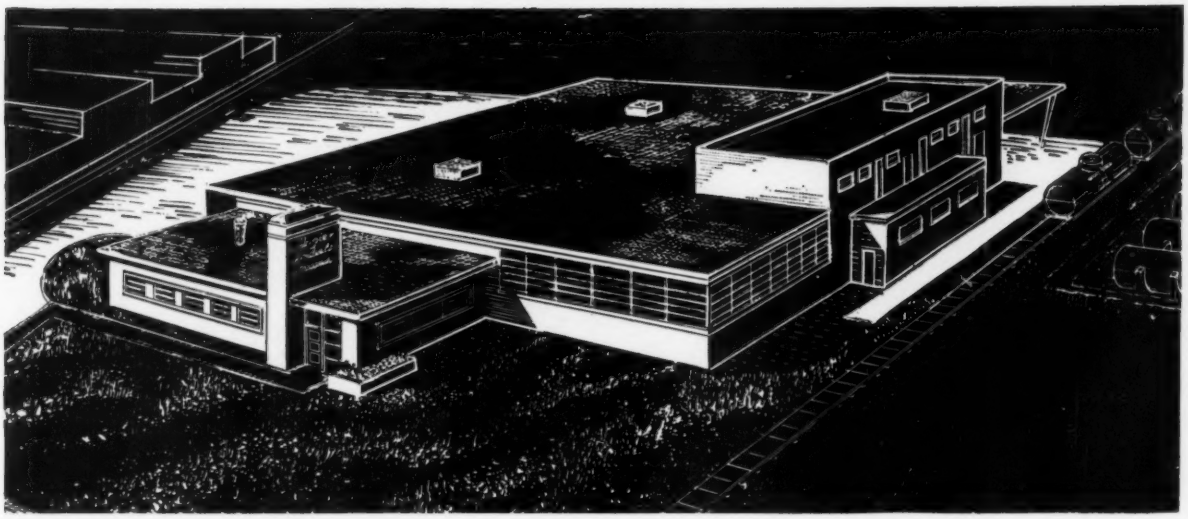

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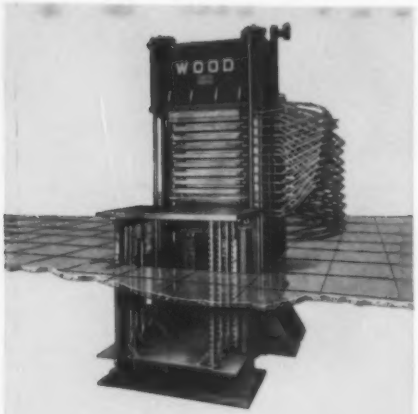


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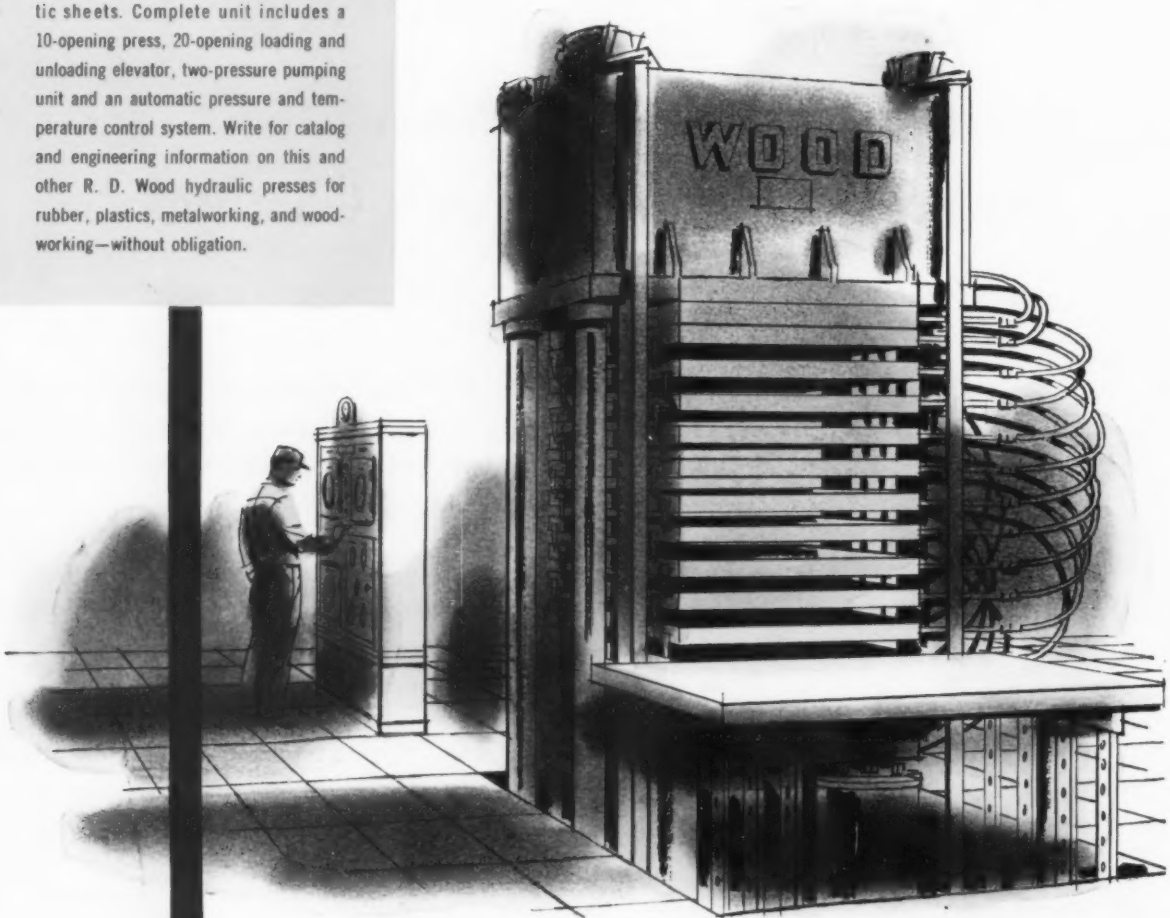


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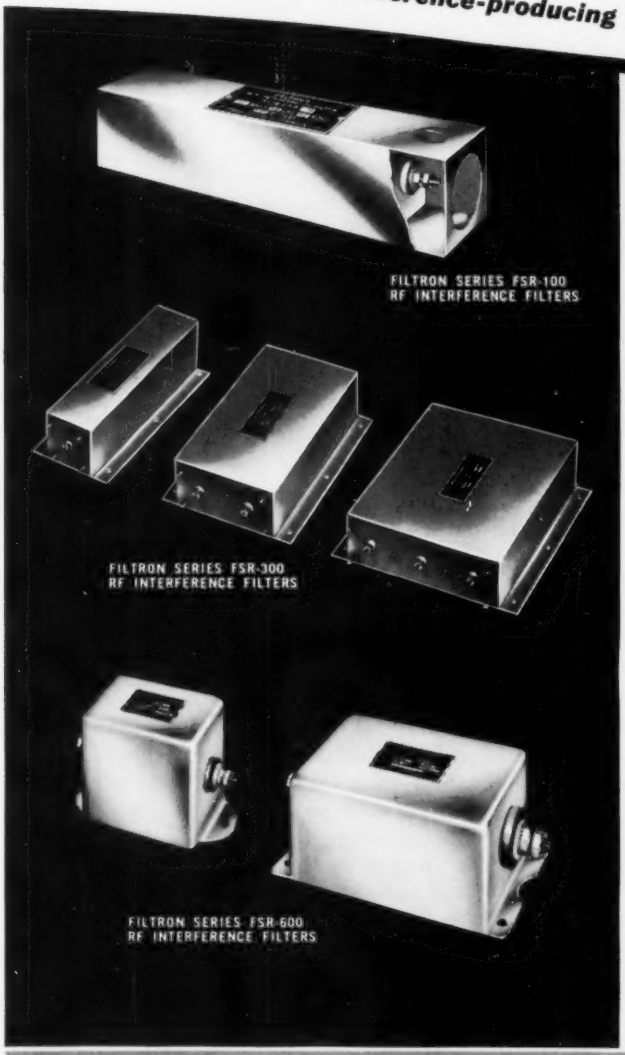

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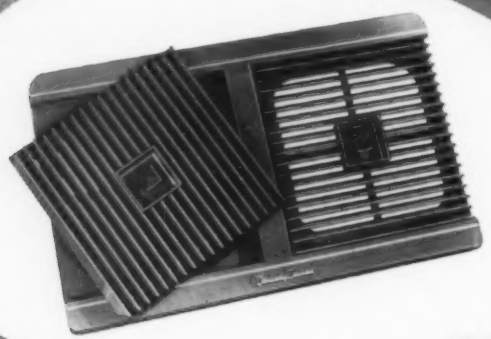

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FOR molding those intricate shapes, for deep drawing, or for larger-than-average pieces, the tested way to easy ejection is to use the right Metasap Stearate in your molding compound.

There are two ways to use these Stearates. Metasap Zinc or Calcium Stearates can be incorporated into the molding compound itself, or simply dusted on the molding surface. Either way, you get improved lubrication at lower ejection pressures. You step up your output, get fewer rejects, and better finished products. Your molds last longer too.

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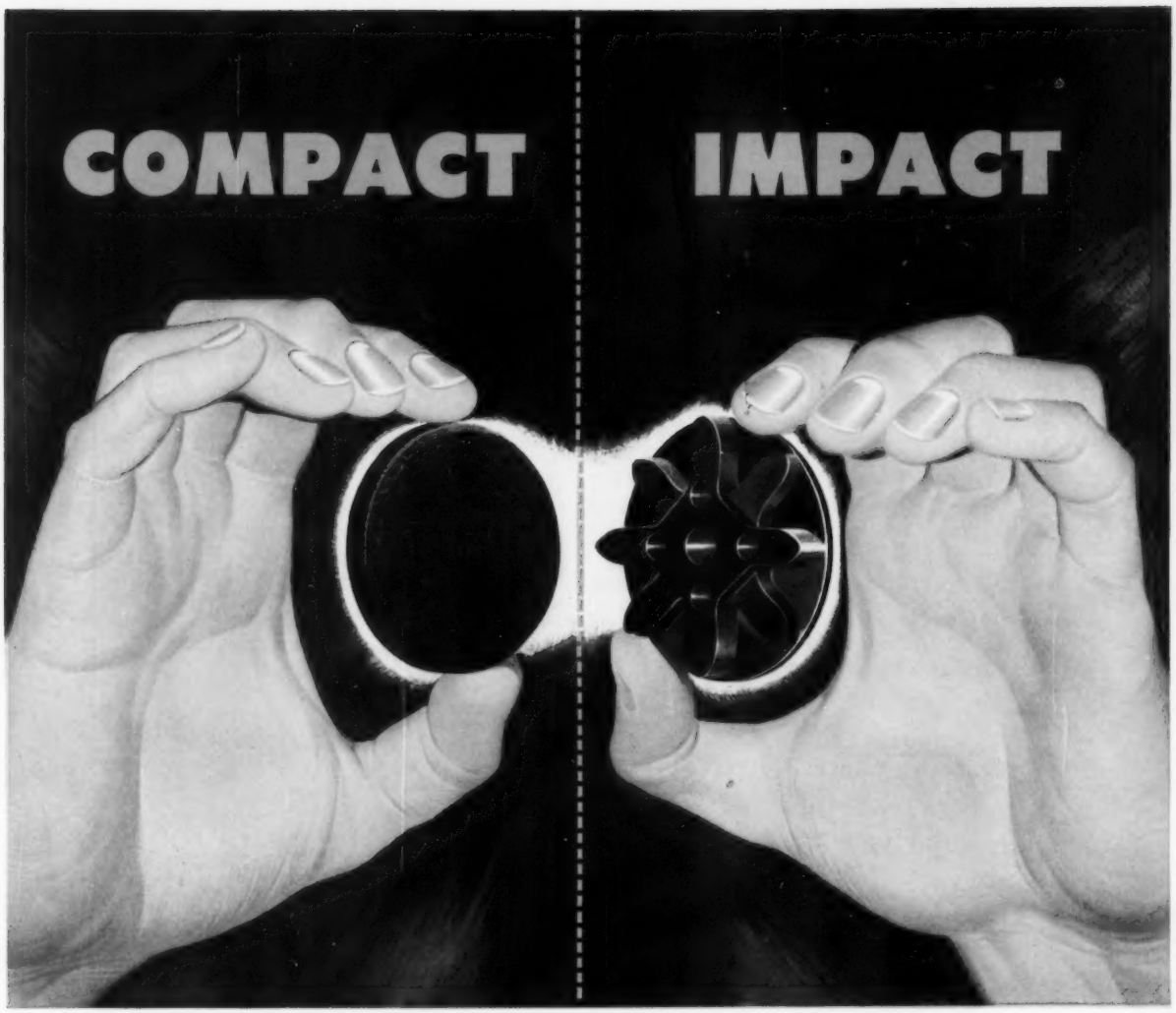
**REPRESENTATIVES:** ST. LOUIS • LOS ANGELES • SAN FRANCISCO • MONTREAL • LONDON, ENG.




# Rogers RX Phenolics

That preform was pilled on high speed, automatic equipment. It's hard and precisely like thousands of others produced for the same run — because it's made of a dust-free, uniformly pelleted material that pours freely. It's one of a range of Rogers RX Impact Phenolics formulated to make high strength parts easier and less expensive to mold.

The bulk factor of these materials is only 3.5 to 1. This compactness is combined with a fast rate of cure. You can mold the material either by transfer or by compression almost as easily as general purpose phenolics. In addition, if you require special molding, physical or flame-resistant characteristics, we can vary RX formulations to produce tailor-made materials.

*Our technical representative nearest you will be glad to lend his assistance in applying Rogers RX Phenolics to your application. For engineering data, please write Dept. P, Rogers Corporation, Rogers, Connecticut.*

## ROGERS CORPORATION

ROGERS, CONNECTICUT

**PRODUCTS**

DUROIDS—for Gaskets, Filters, Electronic Devices, etc.
SHOE MATERIALS—for Counters, Midsoles, Liners, etc.
ELECTRICAL INSULATION—for Motors, Transformers, Generators, etc.
PLASTICS—Special Purpose Molding Compounds and Laminates.

**SERVICES**

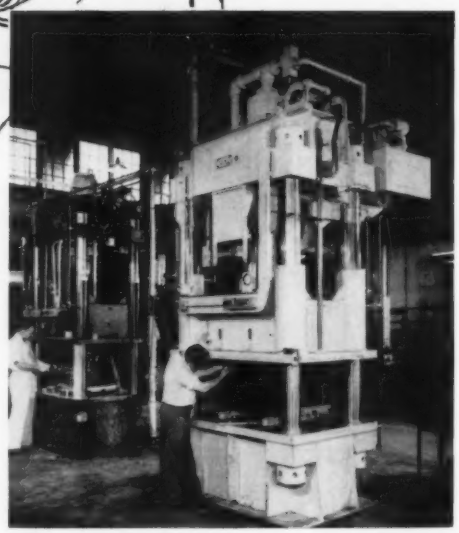
FABRICATING—including Combining, Coating, and Embossing.
DEVELOPMENT—Research and Engineering of New Materials, Parts, and Products.

# YOU WRITE THE TICKET...

# WE WILL BUILD THE PRESS!

**TELL US WHAT FEATURES** you want in your next press for molding reinforced plastics—the advance and closing speeds, the heat and pressures needed, the other features that will improve quality, speed up production, and reduce costs. We will engineer a Dake Press to provide *exactly* what you need . . . just as we are doing for other molders.

Let Dake help you stay abreast of this fast-moving industry, with equipment engineered to keep production geared to modern trends. Write today and tell us what you need.



➡ Here are two of the three Dake Plastics Presses that were built successively over a 30-month period to meet the changing requirements for molding refrigerator parts. Newest is the press at right, which has numerous advanced design features that were not considered possible when the other two presses were built! This is an instance of how rapidly Dake Presses are engineered to keep pace with the needs of the plastics industry.

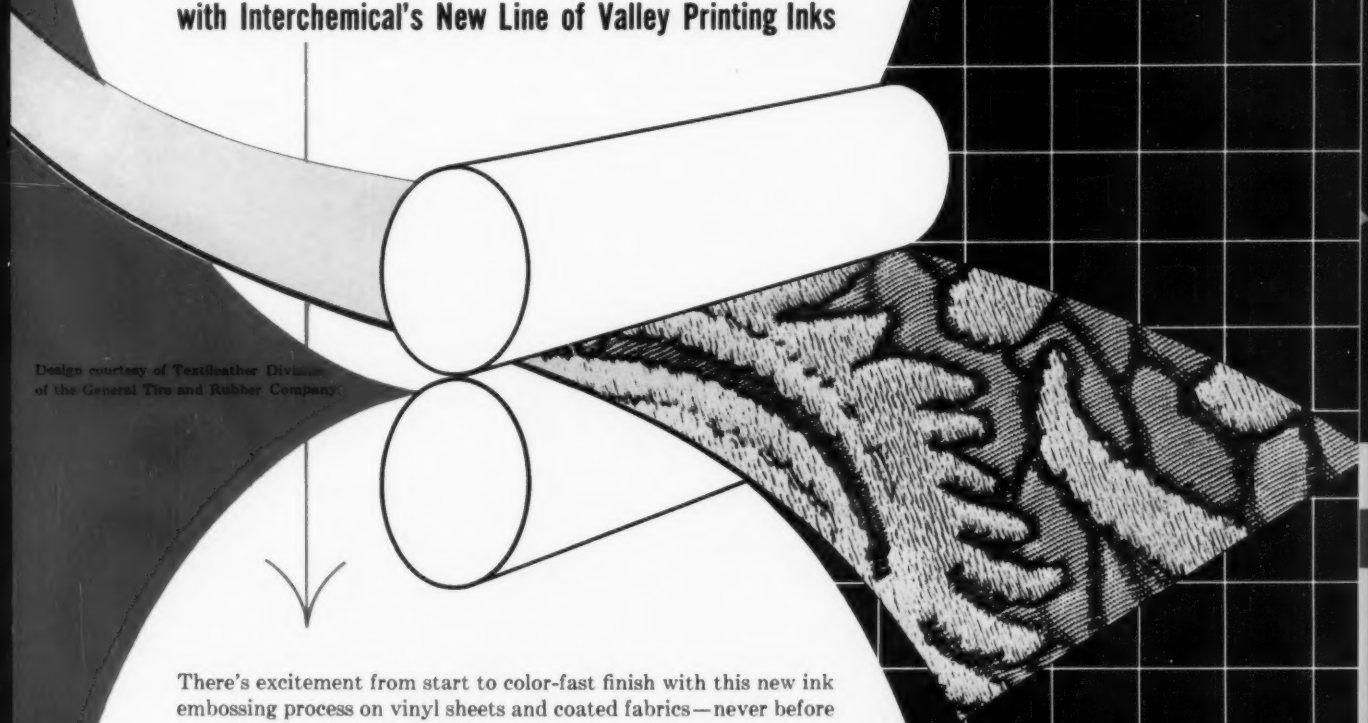
**Dake Engine Company,** 648 Seventh St., Grand Haven, Mich.

**DAKE PRESSES**

## New — 2 Tone, 3 Dimensional Designs on Vinyls

# IN ONE OPERATION

### with Interchemical's New Line of Valley Printing Inks



Design courtesy of Textileather Division of the General Tire and Rubber Company.

There's excitement from start to color-fast finish with this new ink embossing process on vinyl sheets and coated fabrics—never before possible in *one* operation, with *one* roll!

This is *news!* But to print and emboss simultaneously with a single roll, special inks are required to withstand the extremes of heat and cold employed, yet offer maximum adhesion and resistance to abrasion at the same time.

Interchemical's Valley Printing Inks have been developed especially for one operation ink embossing on vinyls in almost any gauge or thickness. These water type inks have been developed to do a superlative job *without* the ever-present fire hazards of solvent type inks and to eliminate roll deterioration because of solvent attack. And, even though they are water based—they *do not re-wet!* Available in a complete range of colors including metallics.

Valley Printing Inks are another fine example of how Interchemical Inter-Related Research helps progressive manufacturers make good products *better* products.

Write for samples and complete details.

**Interchemical Corporation**
FINISHES DIVISION

Factories: Chicago, Ill. • Cincinnati, Ohio • Elizabeth, N.J. • Los Angeles, Cal. • Newark, N.J. • Mexico City, Mex.

In Canada, IC products are sold by AULCRAFT PAINTS LTD., Toronto, Ont., under its trademarks.

# Pumps tricky latex compounds without coagulation

## *with rotor shafts mounted on TIMKEN® bearings*

THE Marco Company, Inc. of Saginaw, Michigan, has found a wide range of applications for its Model AC Flow-Master Commander Pump, operating in some cases up to 1000 psi. These include the pumping and metering of sensitive latex compounds, which become coagulated with even the slightest friction or agitation. Yet the Flow-Master Commander avoids this, by maintaining close tolerances and positive displacement with rotor shafts mounted on Timken® tapered roller bearings.

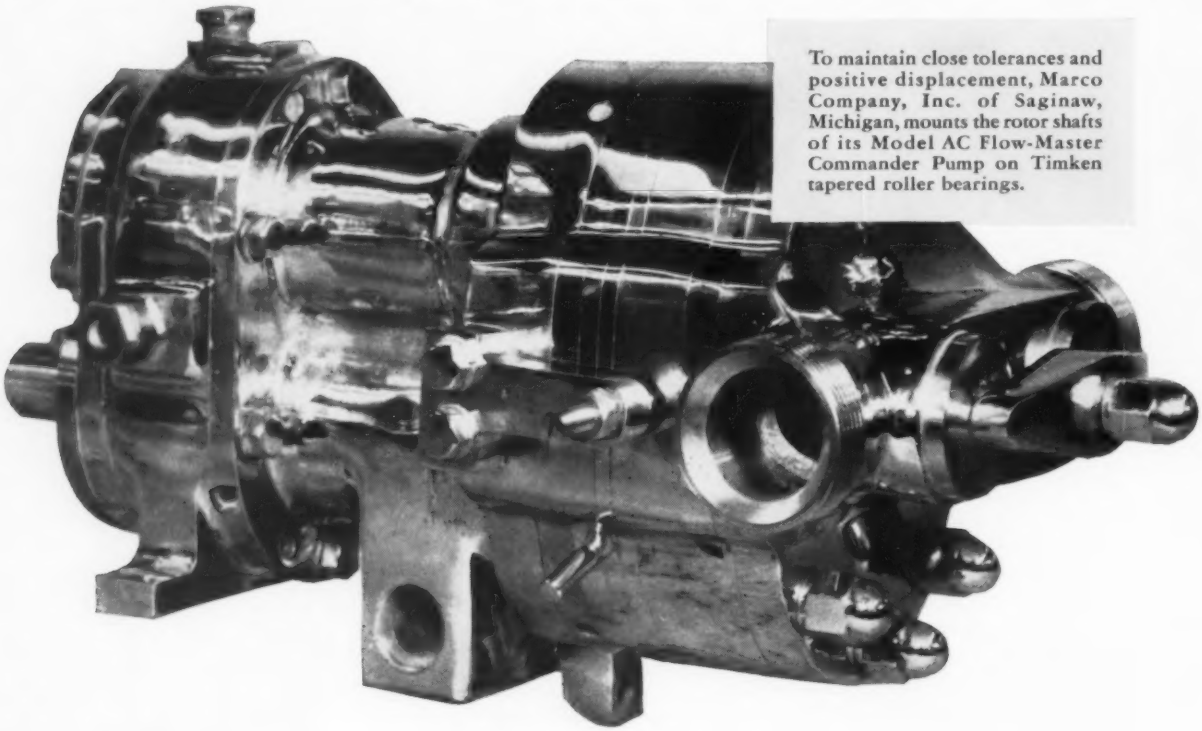
Timken bearings carry both radial and thrust loads in any combination due to their tapered design. Shaft and adjacent parts are held in proper alignment. Wear is minimized.

Timken bearings make closures more effective by holding shafts and housings concentric. Dirt and moisture are kept out—lubricants kept in. Lubrication time and costs are reduced.

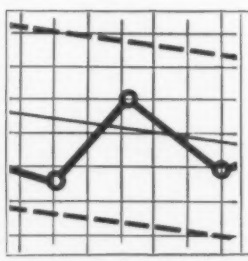
Full line contact between rollers and races gives Timken bearings extra load-carrying capacity. They are designed for true rolling motion and precision manufactured to live up to their design. And they are made of Timken fine alloy steel to assure quality in every bearing.

No other bearing can give you all the advantages of Timken bearings. Specify them in the machinery you build or buy. Look for the trademark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

*This symbol on a product means its bearings are the best.*



To maintain close tolerances and positive displacement, Marco Company, Inc. of Saginaw, Michigan, mounts the rotor shafts of its Model AC Flow-Master Commander Pump on Timken tapered roller bearings.



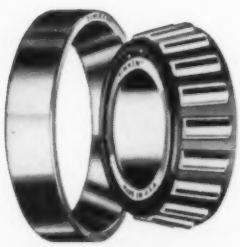
**STATISTICAL QUALITY CONTROL**

To insure uniform high quality and closer tolerances, the Timken Company uses statistical quality control. With it, tolerance deviations are plotted graphically. It's one of industry's newest, most scientific methods of improving product uniformity.

**TIMKEN**

TRADE-MARK REG. U. S. PAT. OFF.

**TAPERED ROLLER BEARINGS**



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▱ BEARING TAKES RADIAL ◫ AND THRUST ⊣◫⊢ LOADS OR ANY COMBINATION ✳

# ASTONISHING . . . a plastic film with impact strength like this

# CHALLENGING to industry . . . the combination of remarkable properties offered by Du Pont MYLAR*

Here's a plastic film that can "take it"! But the exceptional strength of new Du Pont "Mylar" polyester film is only one of the remarkable properties that you can use to improve a product.

- Is space reduction important to your product? The thinness of tough Du Pont "Mylar" may permit you to design smaller equipment.
- Does your product operate at extremes of temperature? "Mylar" retains its operating efficiency from −80°F. to 302°F.
- Need more efficient insulation? "Mylar" has exceptional dielectric strength.
- This versatile film can also be slit into yarn; it can be metalized; it can be bonded to other materials to make durable protective and decorative laminates.

It will pay you to find out more about the properties of "Mylar," and the amazing variety of fields in which "Mylar" is improving products, cutting costs. Mail the coupon for your copy of a new booklet that gives you the facts and figures. It may well suggest ways for you to profit from this new resource of industry. Write: E. I. du Pont de Nemours & Co. (Inc.), Film Department, Wilmington 98, Delaware.

DU PONT
**MYLAR**®
DU PONT POLYESTER FILM
REG. U.S. PAT. OFF.
Better Things for Better Living...*through Chemistry*

E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room 2M, Nemours Bldg.
Wilmington 98, Delaware

Please send me sample and further information on "Mylar" Polyester Film.

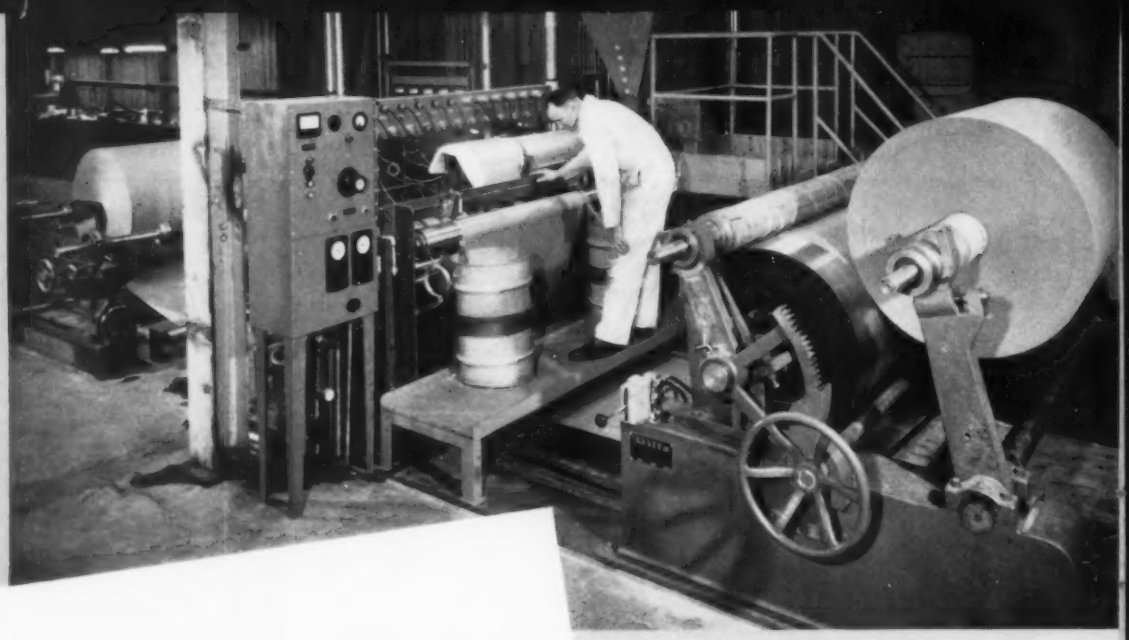
Name_____

Firm Name_____

Street Address_____

City_____ State_____

*Du Pont registered trade-mark for its brand of Polyester Film.



**Guardian paper company**

4246 HOLLIS STREET, OAKLAND 8, CALIFORNIA PIEDMONT 5-6446

December 8, 1954

The Black-Clawson Company
Dilts Machine Works Div.
Fulton, New York

Attention of: Mr. R. J. Jacobs

Dear Bob:

We are extremely pleased with the extruder laminator you built for us. We put the unit into operation last month and within a few days had an excellent salable paper. We are appreciative of the many engineering details incorporated in the machine.

We erected the machinery with local men who were not experienced paper-machine people, and the component parts went together without a hitch. We did not send out any pieces for machining, drilling or change in any way.

We wish to thank you and the engineers in your organization for the excellent start they have given this new company.

Sincerely yours,

Thomas C. Sewell

TCS/jkl

Thomas C. Sewell, President
Guardian Paper Company

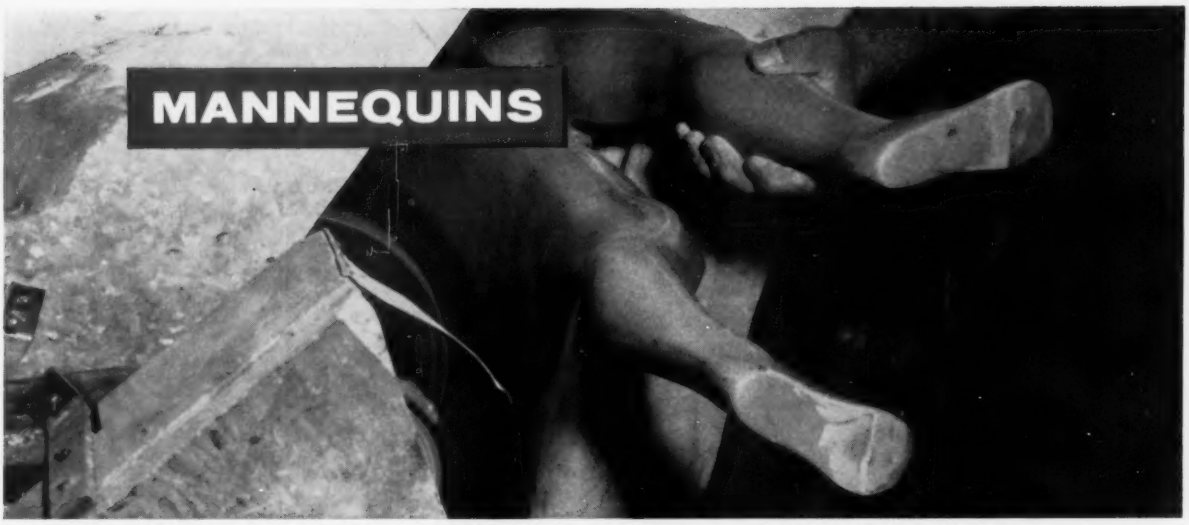
## A New Company off to a Flying Start with a Dilts Polyethylene Extruder-Laminator

The Guardian Paper Company, Oakland, California, began operations with the highly successful start-up of this polyethylene extruder-laminator line engineered for them by Dilts.

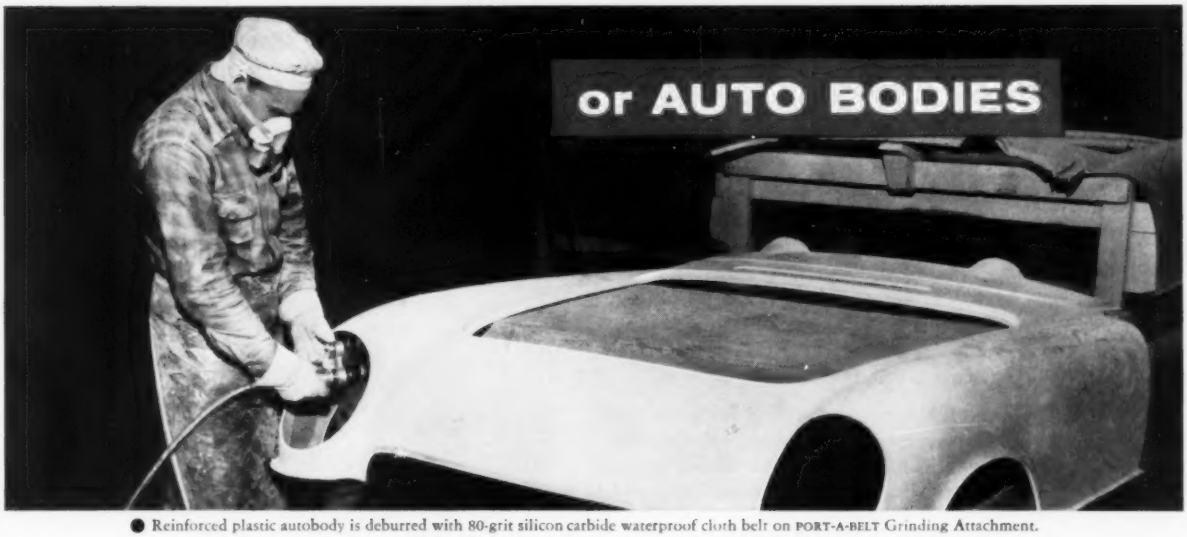
By selecting the proper combination of standard units, Dilts engineers furnished a complete package installation . . . an efficient, economical machine line designed to best meet the new firm's specific production requirements.

**THE BLACK-CLAWSON COMPANY**

**DILTS MACHINE WORKS DIVISION • FULTON, N. Y.**




● Reinforced plastic mannequin parts are finished quickly and smoothly with a Vonnegut head and 80-grit 4" wide loadings.




● Reinforced plastic autobody is deburred with 80-grit silicon carbide waterproof cloth belt on PORT-A-BELT Grinding Attachment.

## *You grind and finish glass fiber-reinforced* **PLASTICS** *best with* **COATED ABRASIVES** *by* CARBORUNDUM

- **WHATEVER YOUR PROBLEMS** in cutting, grinding, finishing or polishing glass fiber-reinforced plastics, *new* coated abrasive products, techniques and tools developed by CARBORUNDUM's abrasive engineers will help you solve them!
- **YOU'LL REDUCE COSTS** and slash finishing time, too... in surfacing large areas, preparing surfaces for coatings, removing wrinkles and blemishes, and finishing complex shapes.
- **CALL YOUR CARBORUNDUM DISTRIBUTOR** or salesman today for a demonstration of these abrasive techniques specially-designed for use on glass fiber-reinforced plastics.

**FREE BOOKLET...**

THE CARBORUNDUM COMPANY
Dept. MP 82-57, Niagara Falls, New York

Please send folder "Grinding Glass Fiber-Reinforced Plastics."

NAME _____ TITLE _____

COMPANY _____

STREET AND NUMBER _____

CITY _____ ZONE _____ STATE _____

*No one matches* **CARBORUNDUM**
REGISTERED TRADE MARK

*in grinding-finishing* **"KNOW-HOW"** *on glass fiber-reinforced* **PLASTICS!**

82-57

*Your best bet for*

# RUNNERLESS MOLDING

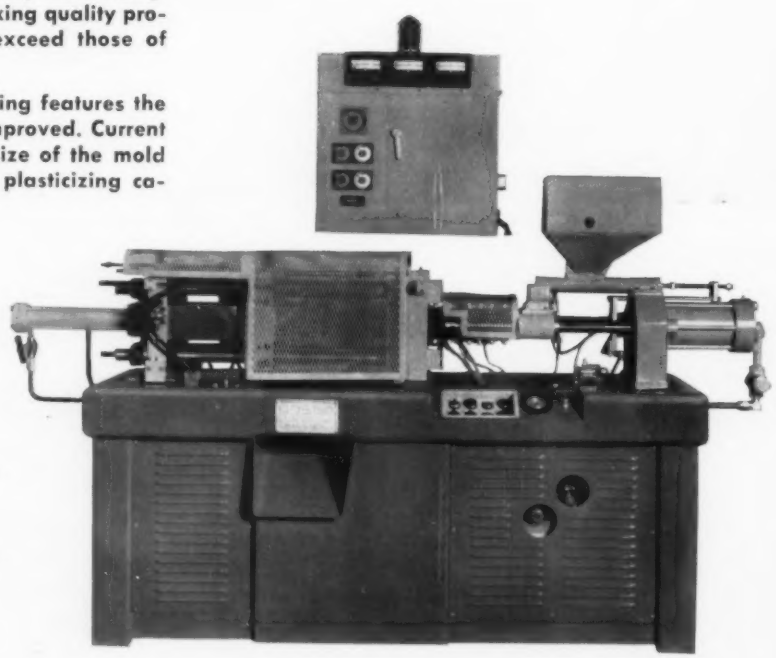
*is with a MOSLO model 75*

- *High Speed*
- *Completely Automatic*
- *Hydraulic Operated*

If you are looking for a high-speed plastic injection molding to do runnerless molding—look no further. The Moslo Model 75 is an ideal machine for this type of molding. It is the plastic molding machine of tomorrow—here today. You get tremendous performance and amazing economies with the Model 75. Not only is the initial investment modest, but the savings in low mold cost plus high production are really astounding. These machines are actually making quality production records that meet or exceed those of much larger machines.

Yet even with these outstanding features the Model 75 is constantly being improved. Current models are much heavier, the size of the mold clamp has been increased, the plasticizing capacity is much greater, plus many other improvements. Of course, the same rugged construction, automatic controls, safety devices, and unique hydraulic manifold system are still a prominent part of every Moslo Machine.

The best way to convince yourself that a Moslo Model 75 is your best bet in plastic molding machines is to see it perform. We invite you to visit our plant and we will gladly make a demonstration using your molds. Should you want immediate additional information, we will be glad to send it. But under any condition, if you are in the market for a plastic injection molding machine—see Moslo first—pioneers in runnerless molding.



## Improved Features of the Model 75

| | |
|---|---|
| • Plasticizing capacity | 70 lbs. per hour |
| • Cycles per hour—dry run | 750 |
| • Maximum injection pressure | 20,000 P.S.I. |
| • Mold opening | 8 inches |
| • Mold size | 11 7/8 inches x 15 inches |
| • Mold thickness—minimum | 8 inches |
| • Mold thickness—maximum | 13 inches |
| • Mold locking force | 145 tons |

## MOSLO MACHINERY COMPANY

2443 PROSPECT AVENUE • CLEVELAND 15, OHIO

# GERING

## a complete plant for

## COMPLETE SERVICE

CUSTOM COMPOUNDING • REPROCESSING
S-T-R-E-T-C-H • DRYCOL • STYROMIX
EXTRUSIONS • GER-PAK POLYETHYLENE FILM, SHEETING, LAYFLAT TUBE
GER-FLEX VINYL TUBING • GER-TUBE POLYETHYLENE TUBING

*SERVING THE ENTIRE PLASTICS INDUSTRY*

**POLYETHYLENE**
**ETHYL CELLULOSE**
**POLYSTYRENE**
**BUTYRATE**
**ACETATE**
**ACRYLIC**
**VINYLS**
**NYLON**

**CUSTOM COMPOUNDING**
complete equipment to produce large quantities of molding and extrusion compounds

**DRYCOL**
perfected medium for easy-on-the-spot dry coloring—standard and special effects

**S-T-R-E-T-C-H**
polyethylene colorant — saves up to 15¢ per product lb.—easy, clean, safe, dustless

**STYROMIX**
blended ready-mixed styrene in required color — money-saver — production-speeder

**PURGING COMPOUND**
specially formulated rapid releasing agent for injection molding machine cylinders.

**RE-PROCESSING**
of plastic scrap and obsolete molding powders—we buy and sell

# GERING *Products, Inc.*

"PIONEERS IN MODERN PLASTICS FOR OVER 30 YEARS"

KENILWORTH, N. J.

# This mold maker is writing molded plastics "specs" in steel

The mold shop is the place where close tolerance "specs" for molded plastics are met. It's here that engineering ideas are translated into the tools to do the job. If costs are to be kept in line and deliveries met, the mold making job must be "right on the button" the first time.

At Quinn-Berry, the mold shop is only a few steps away from both engineering and production. The lost time and motion of geographically separated and independently owned facilities are eliminated. Skilled mold makers are an integral part of the Quinn-Berry planning and production team every step of the way.

This undivided responsibility has solved problems —and saved money—for many molded plastics parts buyers. Your problem may be one that Quinn-Berry can solve in like manner. Just call the nearest Quinn-Berry sales engineer listed below.

**DETROIT, Mich.**
Harry R. Brethen
15 Lawrence
*Townsend* 8-2577

**ARDMORE, Pa.**
Austin L. Wright
P.O. Box 561
*Hilltop* 7-0345

**MILWAUKEE, 13, Wisc.**
John Weiland, Jr.
7105 Grand Parkway
*Greenfield* 6-7161

**EAST ROCHESTER, N.Y.**
Harwood Molded Products
Fairport Road
941

**BRONXVILLE 8, N.Y.**
Edwin S. Dunbar, Jr.
64 Kensington Road
*Deerfield* 7-7709

**DAYTON 9, Ohio**
G. R. Vines
637 Monteray Avenue
*Walnut* 5174

**QUINN-BERRY CORP.**
**PLASTICS**

**2651 WEST 12th STREET, ERIE, PENNA.**

**MOLDERS OF ALL TYPES OF THERMOPLASTIC MATERIALS**

# Now Puerto Rico Offers 100% Tax Exemption to New Industry

*by BEARDSLEY RUML*

"We don't want runaway industries" says Governor Muñoz. "But we do seek new and expanding industries." Federal taxes do not apply in Puerto Rico, and the Commonwealth also offers full exemption from local taxes. That is why 300 new plants have been located in Puerto Rico, protected by all the guarantees of the U. S. Constitution.

Beardsley Ruml

IN A dramatic bid to raise the standard of living in Puerto Rico, the Commonwealth Government is now offering U. S. manufacturers such overwhelming incentives that more than three hundred new factories have already been established in this sun-drenched island 961 miles off the Florida coast.

First and most compelling incentive is a completely tax-free period of ten years for most manufacturers who set up new plants in Puerto Rico.

**For example, if your company is now making a net profit after taxes of $53,500, your net profit in Puerto Rico would be $100,000—a gain of 87 per cent as a result of non-applicability of U. S. Corporate Income Tax in Puerto Rico.**

Your dividends in Puerto Rico from a corporation there could be $50,000 against $25,000 net in the U. S.—owing to the non-applicability of the U. S. Income Tax.

### What About Labor?

Puerto Rico's labor reservoir of 650,000 men and women has developed remarkable levels of productivity and efficiency—thanks, in part, to the Commonwealth's vocational training schools. These schools also offer special courses for managers and supervisors.

**The progress made in technical skills may be gauged from the fact that there are now twenty-eight factories producing delicate electronic equipment.**

Among the U. S. companies that have already set up manufacturing operations in Puerto Rico are Sylvania Electric, Carborundum Company, St. Regis Paper, Remington Rand, Univis Lens, Shoe Corporation of America, and Weston Electric.

**CORPORATE TAX EXEMPTION**

| If your net profit after U. S. Corporate Income Tax is: | Your net profit in Puerto Rico would be: |
|---|---|
| $ 17,500 | $ 25,000 |
| 29,500 | 50,000 |
| 53,500 | 100,000 |
| 245,500 | 500,000 |
| 485,500 | 1,000,000 |

**DIVIDEND TAX EXEMPTION**

| If your income* after U. S. Individual Income Tax is: | Your net income in Puerto Rico would be: |
|---|---|
| $ 3,900 | $ 5,000 |
| 7,360 | 10,000 |
| 10,270 | 15,000 |
| 14,850 | 25,000 |
| 23,180 | 50,000 |
| 32,680 | 100,000 |
| 43,180 | 200,000 |
| 70,180 | 500,000 |

*These examples are figured for dividends paid in Puerto Rico to a single resident. Based on Federal rates effective Jan. 1, 1954.

### "Close to Paradise"

Listen to what L. H. Christensen, Vice President of St. Regis Paper, says:

*"The climate is probably as close to paradise as man will ever see. I find Puerto Ricans in general extremely friendly, courteous and cooperative.*

*"This plant in Puerto Rico is one of our most efficient operations, in both quality and output. Our labor has responded well to all situations."*

Mr. Christensen might have added that the temperature usually stays in the balmy 70's twelve months a year.

The swimming, sailing and fishing are out of this world. Your wife will rejoice to hear that domestic help is abundant.

The Commonwealth will leave no stone unturned to help you get started. It will build a factory for you. It will help you secure long-term financing. It will even screen job applicants for you—and then train them to operate your machines.

### Transportation

Six steamship companies and four airlines operate regular services between Puerto Rico and the mainland. San Juan is just 5½ hours by air from New York.

Light-weight articles such as radar components come off the line in Puerto Rico one day and are delivered by air freight next day in Los Angeles, Chicago and other mainland cities. And, of course, there is no duty of any kind on trade with the mainland.

### Are You Eligible?

Says Governor Muñoz: *Our drive is for new capital. Our slogan is not "move something old to Puerto Rico," but "start something new in Puerto Rico" or "expand in Puerto Rico."*

The Commonwealth is interested in attracting all suitable industries, and especially electronics, men's and women's apparel, knitwear, shoes and leather, plastics, optical products, costume jewelry, small electrical appliances, hard candy and pharmaceuticals.

**To get all the facts, and to find out whether you and your company would be eligible for complete tax exemption, mail the coupon below.**

**MAIL THIS COUPON**

**Economic Development Administration**
**Commonwealth of Puerto Rico, Dept. P-2**
**579 Fifth Avenue, New York 17, N. Y.**

Mail me "Facts for Businessmen," your report of the advantages of Puerto Rico for plant location.

**Name**_____

**Company**_____

**Product**_____

**Address**_____

*Secret's in the Shape!*

*National*

MALEIC ANHYDRIDE TABLETS

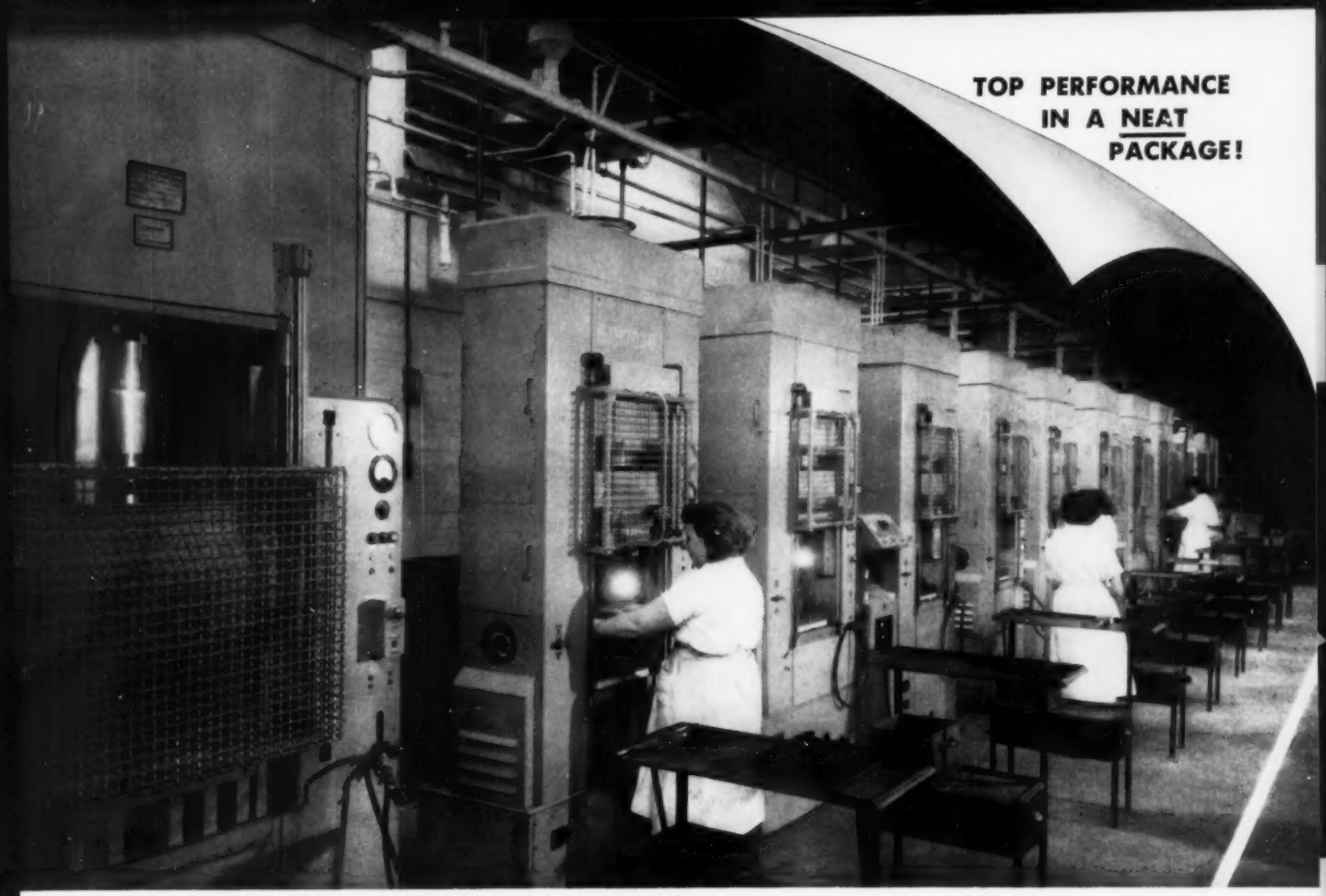
*up to 75-90% fewer fines because of smooth "cornerless contour" and lower surface-area/weight*

"As Delivered" National Maleic Anhydride Tablets are easy to handle, uniform and quick to dissolve. That's why they will appeal to your operators.

Economical, too, in minimizing inventory because our modern new plant on the Ohio River at Moundsville, W. Va. can deliver so promptly by rail, truck or inland waterway. All of which are good reasons for specifying "National Maleic Anhydride Tablets" on your next order. Phone our nearest office for samples, specifications and prices.

**NATIONAL ANILINE DIVISION**
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Boston Providence Philadelphia Chicago San Francisco
Portland, Ore. Greensboro Charlotte Richmond Atlanta
Los Angeles Columbus, Ga. New Orleans Chattanooga Toronto



**TOP PERFORMANCE IN A NEAT PACKAGE!**

*Fewer Rejects, Higher Output and Lower Maintenance With*

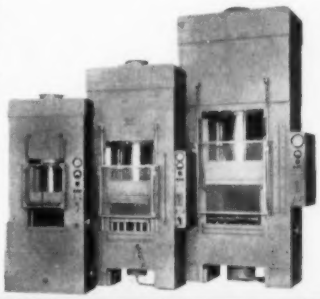
# BIPEL Compression-Transfer Presses

Here, all wrapped up in the most compact units imaginable, are the ultimate in precision and economy in compression-transfer presses! Rejects are virtually eliminated: BIPEL'S "Auto-Control" automatically reproduces any required molding cycle at the touch of a button. No room for time-wasting "human error" here! Perfect timing means extra cycles per hour too. Closer temperature control and effective heat transfer to work is accomplished by induction heated platens (also available separately for your present presses).

But BIPEL'S compactness means even more economy. Each press occupies far less space, without projecting "accessories" and superfluous piping. A central out-of-the-way drive system delivers an economical 1000 psi pressure for up to 12 presses, with pressure doubled or tripled at will *within* the press, to meet your immediate requirements. An individual drive may be built within the press frame for single installation. Electricals to suit.

---

There are many other BIPEL features you'll want to know about. Write today for the complete story . . . in interesting, illustrated folders. *Let us demonstrate these presses for you at our Tiverton, R. I. plant. Spare parts and complete service available at all times.*



**BIPEL Presses available in 3 models, each offering a selection of 3 pressures:**

**TYPE 40: 20, 40, and 60 tons***
**TYPE 100: 50, 100, and 150 tons***
**TYPE 200: 100, 200, and 300 tons***
***Long Ton: 2240 lbs.**

*Ask about famous BIPEL Hydraulic Pelleters . . . in such demand that units were ordered from users in 10 states in the first 8 months!*

"BIPEL" is a Registered Trade Mark — World patents granted or pending

B·I·P

**B.I.P. ENGINEERING, LTD.**
Streetly Works, Sutton Coldfield, England

American Inquiries to

**RALPH B. SYMONS ASSOCIATES, INC.**
3571 MAIN ROAD TIVERTON, R. I.

**..this is BIPEL**

# where durability counts...

## SPECIFY EMERY PLASTOLEIN 9720

*...and give your plastics "lasting power"—greater sales appeal!*

Where your plastic must stand up to the constant wear of boys' shoes on bus seats... or the cold, rain and sun on auto upholstery... or the eroding elements of the weather on lawn furniture... Emery Plastolein 9720 will give it outstanding durability, weatherability, resistance to wear, and "wipe-off." And since it is the lowest priced polymeric plasticizer available, you get these benefits at lowest cost.

A polyester type compound, this unusually stable plasticizer was compounded specifically to provide durability in heavy-gauge vinyl sheeting. It provides unusually low volatility, high resistance to oil and water extraction, excellent stability to heat and light, and high resistance to migration. Moreover, it is easier to handle, more readily pumped and shipped in bulk than other common polymeric plasticizers.

These characteristics can be important to you. That's why it will pay you to evaluate Plastolein 9720 in your formulation.

Write today to Dept. F-4 for descriptive booklet or for evaluation samples.

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MODERN PLASTICS

APRIL 1955 VOLUME 32 NUMBER 8

Photos courtesy The Marblette Corp.

**Large-volume outlet for sheet forming is in display field. By preprinting a sheet in distortion and then forming it over a phenolic die . . . . . so that the colors register in exact position on the formed piece, substantial savings in finishing costs are made possible**

# Plastics' Junior GIANT

## Production of three-dimensional shapes from wide variety of thermoplastic sheets by various forming methods now takes its place as a major processing technique

IN FIVE short years, translations and extensions of methods long used in forming nitrate, acetate, and acrylic sheet, applied to newer thermoplastics, have loomed ever more important in large-volume, low-cost production.

By vacuum and/or pressure, thermoplastic sheets are today being formed into three-dimensional products and product components at a rate that must place sheet-forming right alongside the more conventional processing methods as a major fabricating technique in the plastics industry.

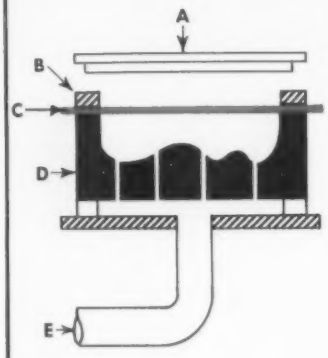
In just the 12 months since MODERN PLASTICS made an over-all survey of this expanding field (see "Shape a Sheet," MODERN PLASTICS *31*, 87, May 1954), much has happened. Custom sheet formers have stepped up their activities and several large producers have added their names to the list; in addition, a number of proprietary sheet formers in the hundreds-of-millions-of-units-per-year category have entered the field. At the same time, major material suppliers, attracted by the 200 million or more pounds of plastics which it is believed the sheet forming industry will be consuming annually by 1960, are hard at work in improving their thermoplastic sheet formulations.

### Machinery, Methods

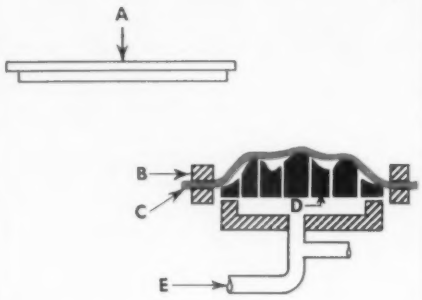
Credit for the present interest in sheet forming belongs in large part to the excitement generated in the

# Sheet Forming Techniques

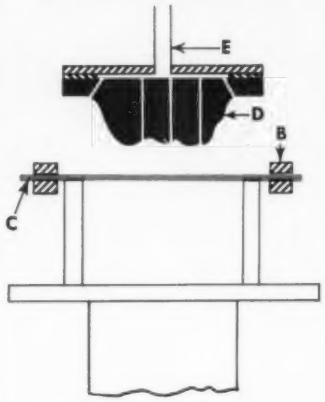
### 1. STRAIGHT VACUUM FORMING



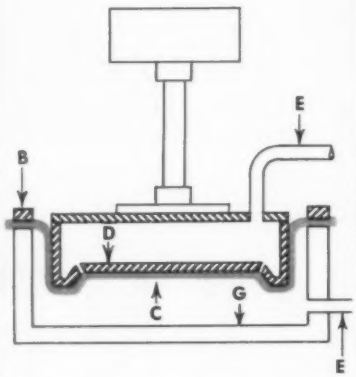

### 2. DRAPE VACUUM FORMING




### 3. FORCE ABOVE SHEET




### 4. VACUUM SNAP-BACK FORMING




A WIDE variety of sheet forming techniques are available to satisfy many different types of job requirements. Most of these are variations of the following basic methods:

**1) Straight Vacuum Forming**—Clamped in stationary frame, heated sheet is vacuum-drawn into mold.

**2) Drape Vacuum Forming**—Movable frame stretches sheet over male mold before vacuum is pulled.

**3) Force Above Sheet**—Mold descends onto heated sheet, partially forming it; vacuum is then pulled.

**4) Vacuum Snap-Back Forming**—Vacuum is pulled, drawing preheated sheet into cavity (G). Male plug moves down until it reaches a predetermined position. Vacuum is then applied in male plug.

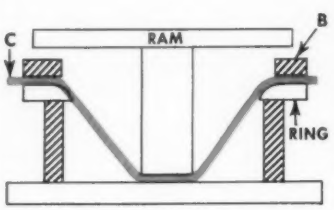
**5) Plug and Ring Forming**—Heated sheet is placed over a ring and clamped down. Mold mounted on ram is forced into it.

**6) Forming into Female with Helper and Air Pressure**—As press closes, cored plug pushes heated sheet into cavity. Air pressure is then introduced through cored plug, pushing sheet into female mold. Holes in mold let air escape.

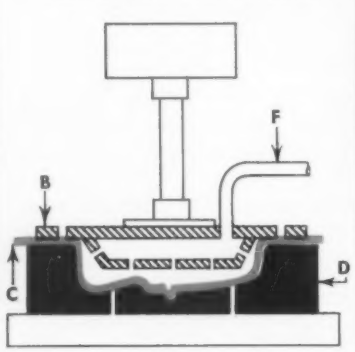
**7) Pressure Forming**—After heating, framed sheet is formed between matched male and female dies.

**Legend: A—Heater; B—Clamp; C—Plastic Sheet; D—Mold; E—Vacuum Line; and F—Air Pressure Line.**

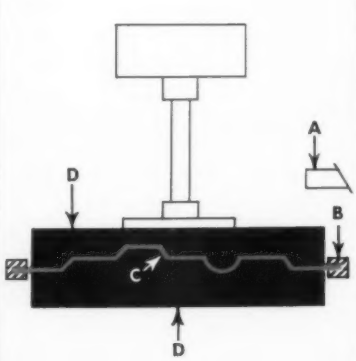
### 5. PLUG and RING FORMING

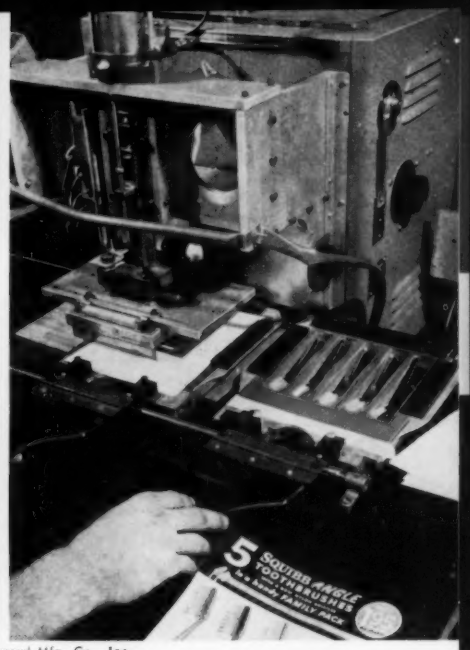



### 6. FORMING INTO FEMALE WITH HELPER AND AIR PRESSURE




### 7. PRESSURE FORMING






Photos courtesy Hernard Mfg. Co., Inc.

**Modern trend toward multiple-unit sales finds expression in transparent family pack for toothbrushes. The contoured covers of the pack are formed of acetate sheet in a 75-cavity mold . . . . . Cover with toothbrushes in place is then heat-sealed to acetate backing . . .**

plastics industry by the introduction of the commercial vacuum forming machine in 1951. Although even then the use of vacuum or pressure for sheet forming was not a new concept, the availability of a low-cost machine incorporating heater, mold, and vacuum pump in a single unit immediately opened new possibilities for large-volume markets.

Inherent in vacuum forming techniques are outstanding advantages that recommend them for literally thousands of applications. Vacuum forming is more adaptable to the mass production of thin-wall, broad-area objects than is any molding process. Equipment costs are relatively small (the range is from approximately $1000 to $15,000) and tooling costs are proportionally low; set-up time is fast and production rate can be effectively speeded up by the use of multi-cavity molds; very large objects can be formed at relatively small mold costs; and decorating time and costs can be reduced by using plastics sheets preprinted in distortion in the flat and then formed with colors and designs in exact position on the formed piece.

## Combination Techniques

Where vacuum forming techniques are limited in effectiveness by heavy gage of the plastics sheet or by intricate design of the fabricated part, conventional pressure forming methods, such as plug-and-ring, or the custom-designed combination vacuum and pressure methods can be used.

In the latter case, several machinery manufacturers and custom formers interviewed in the course of this survey feel that eventually specialized equipment will evolve that combines the advantages of both vacuum and pressure forming techniques. Such equipment will be designed to supplement general-purpose machines in meeting the requirements of specific end-use applications.

Packaging is an outstanding example. One machinery manufacturer described tomorrow's sheet forming machine for the packaging industry as being larger than the general-purpose machines in use today; it would be web-fed and completely automatic in operation; it would have faster cycling; and all trimming and filling operations would be carried on in the press. To complete this "dream" machine, a conveyor belt would carry the containers through any additional finishing operations that might be necessary. The entire unit would be designed to lower the unit cost of the package by providing the maximum in high-speed, efficient mass production.

**. . . resulting in sales-stimulating package that gives complete protection**

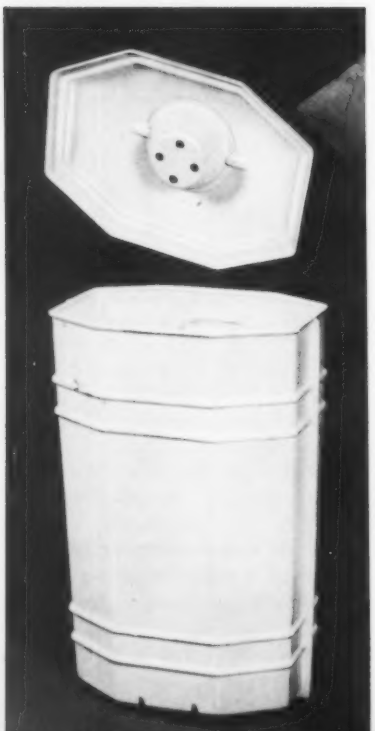
Today's fabricator has a wide selection of sheet forming equipment at his fingertips. In the $1000 to $15,000 range, he can choose between straight vacuum forming machines or combination straight and drape vacuum forming units; he can select a machine with virtually any degree of control from all-

Spoon display, standing 5 ft. high, is formed in two halves of brilliant silver-metallized butyrate sheet and cemented together around wire skeleton

Courtesy Coating Products

Availability of extra-tough, glossy styrene sheet looms as major factor in developing refrigerator industry as prime market for vacuum formed components

Courtesy Regal Plastic Co.



Size is no limitation when diaper can is formed in two halves from styrene sheet and the pieces welded together

manual to completely automatic; and he can have a model which, with accessory equipment, can handle a wide range of individual specialized jobs.

Despite the simplicity of the basic sheet forming operation, there is more to the technique than first meets the eye. Sheet forming, like other plastics processing techniques, calls for careful selection of materials, close attention to tooling, and soundly engineered end-products before it begins to pay off in dollars and cents.

As described in the May 1954 issue of MODERN PLASTICS, the fabricator also has available a wide range of mold materials—plaster, wood, cast phenolic, cast epoxy, cast aluminum, and metal; he has an equally wide selection of trimming and die cutting equipment. The prospective sheet former must make his choice not only on the basis of economy, but also on the specific results required for the finished product.

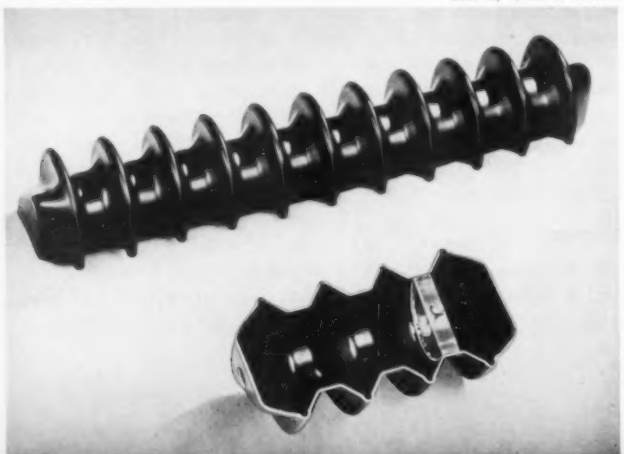
## Intricate Design

Sheet forming is not as simple as it first appears, but neither does it have as many design limitations as might be expected. In the May 1954 article, for example, undercuts were described as being particularly difficult to achieve. Today, only 12 months later, the picture has changed.

Several outstanding examples of products formed with intricate undercuts have already appeared and more are on the way. A number of these applications have been produced by forming the plastic sheet around "orphan" inserts pinned to the male mold. When the formed

Despite intricacy of design, yarn guide for the textile industry is successfully formed in one piece of 0.125 in.-thick styrene copolymer sheet

Courtesy Gladwin Plastics



piece is removed from the mold, these orphan inserts remain in place in the piece. The shape of the undercut section is thus retained and extra support is lent to the overhanging lip of the undercut. (For an example, see "Freezers Go to Vacuum Forming," MODERN PLASTICS *32*, 94, Feb. 1955.)

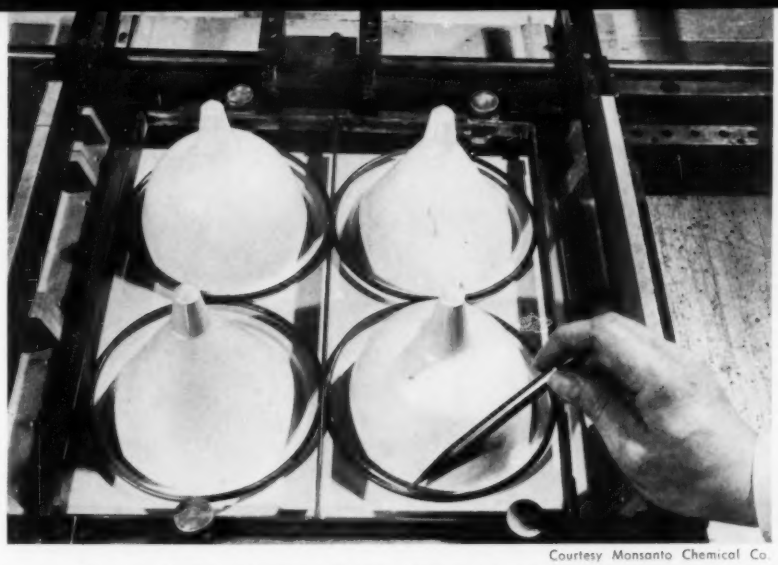
For applications where it is not desirable to leave the insert in the formed piece, hinged inserts have been designed. In such cases, when the formed piece is pulled up from the mold, the hinge collapses, permitting the insert to slide easily out of the formed undercut section.

### Pattern Heating

For handling some intricate design problems, grid or pattern heating can be used. As the name implies, this method makes use of a metal screen suspended between the heater and the plastic sheet prior to forming in order to hold back heat from those areas where the draw, and consequently the thinning, would normally be the greatest.

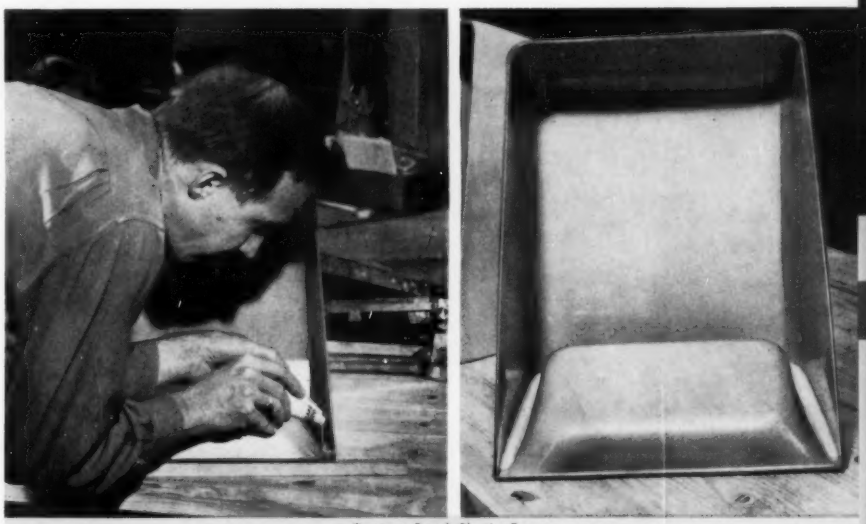
Companion method to pattern heating is pattern cooling. Here, air jets are applied to those areas of the sheet at which the draw is greatest, in order to cool them and thus reduce thinning at such points.

Another popular technique is use of the drape-assist frame. The frame, which is suspended above the sheet to be formed on the male mold, can be made up of anything from thin wires to thick bars shaped to the peripheries of the depressed areas of the mold. After the movable clamp has lowered the sheet over the mold, the assist frame drops down, drawing the sheet even tighter. It thus prevents webbing between high areas of the mold and permits closer spacing of molds.



Courtesy Monsanto Chemical Co.

**For more effective performance in drape forming over multi-cavity molds, assist frames (pencil) can be dropped over sheet during forming to prevent webbing between pieces**



Courtesy Regal Plastic Co.

**Problem of thinned-out groove in deep-drawn styrene copolymer housing is overcome by pouring foamed-in-place isocyanate into groove (left) and allowing it to harden into a rigid bead (right)**

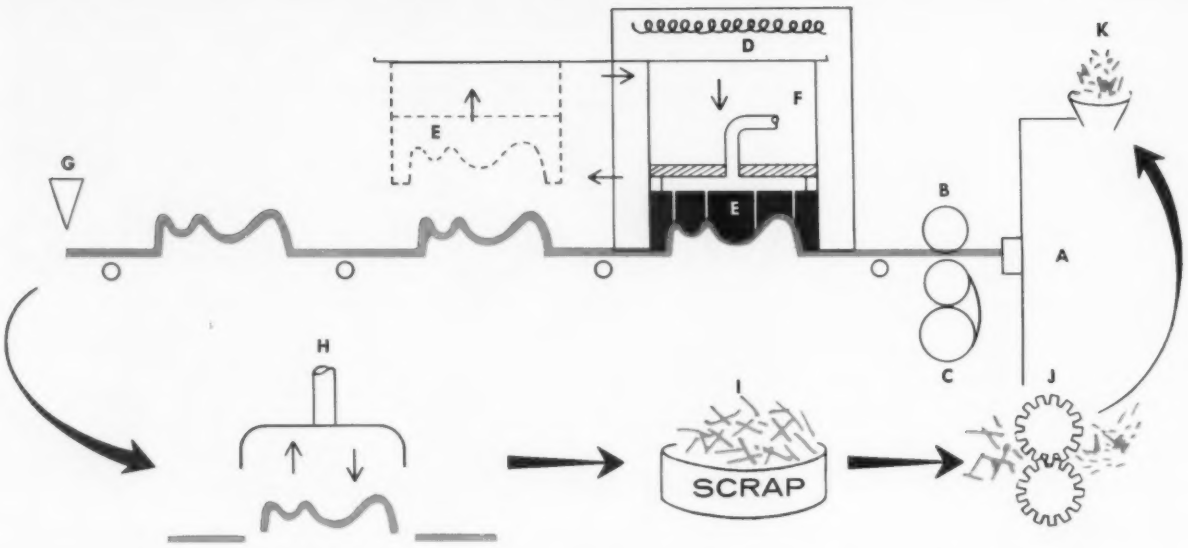
### Continuous Operation

While the techniques described above will open new fields of opportunity for sheet forming, the real future of the entire sheet forming industry lies in continuous operation direct from a roll of material or from an extruder.

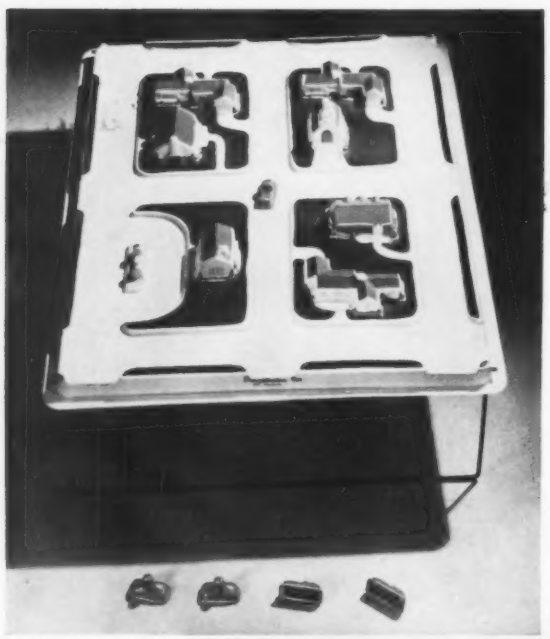
Most fabricators agree that where production volume reaches into the tens and hundreds of millions of units and the job requires some two to three months to be run, the continuous process is most feasible. Exactly how big and how long the run has to be before this point is reached, however, is still open to debate.

Some fabricators point to the fact that the high costs required for the installation and maintenance of an extruder-forming set-up would have to be offset by production operations on a 'round-the-clock basis. In addition, synchronization of the extruder and the forming machine would require constant and continuous control. A break-down anywhere would mean a shut-down of the entire line.

However, there are fabricators who feel that everything, from medium-size runs on up, is a candidate for continuous extrusion-forming operations. They maintain that since the plastic sheet is still hot as it comes out of the extruder, preheating time is cut down or eliminated completely, thereby decreasing the forming cycle. In addition, there is no necessity for mechanical handling of sheet material and, consequently, little danger of the sheet becoming scratched or contaminated. Finally, storage and handling costs are greatly re-




Continuous extrusion-forming, as set up by Robinson Mfg., Inc. (see text on opposite page): A—extruder; B—metal roller; C—roll of 1 to 3 mil flexible styrene sheet; D—heater in oven; E—female mold (arrows denote movement of mold); F—vacuum line; G—manual cut-off; H—die cutting of formed piece; I—scrap from die cutting; J—grinding scrap; K—feeding scrap into hopper



In toy applications, adaptability of sheet forming to novelty design has proved itself. This colorful toy town, which includes miniature cars (foreground), for example, is formed entirely of plastic sheet

Courtesy Duraplastics, Inc.

Heralded as new concept in packaging of perishable foods, cheese container is formed of 20-mil polyethylene sheet. Polyethylene coated cellophane is heat-sealed to top of container

Courtesy Samuel Fogel Consultants

duced. All these factors point to lower unit cost.

General American Transportation Corp., Chicago, Ill., which maintains both a continuous extrusion-forming operation and individual sheet forming machines for refrigerator parts, machine housings, and automotive applications, has analyzed comparative costs and indicates that the in-line process is more economical and at least 50% faster than conventional forming methods.

The technique of roll-feeding sheets of plastics material into the forming process has many of the same advantages and limitations as the continuous extrusion-forming technique. Again, some fabricators feel that the process, especially since much of it is manual, needs large production runs to be economical.

Of the many jobs handled by Valley-National Corp., Milldale, Conn., the company found that only a large-run Government job entailing the production of ¾ million units over a period of several months warranted the use of roll-feed methods.

## Production Techniques

Continuous automatic forming has been in use for a long time in a few plants. In 1952, for example, Federal Tool Corp., Chicago, Ill., announced the installation of a continuous production line. (See "Picnic Plates Vacuum Formed," MODERN PLASTICS 29, 92, Aug. 1952.)

A second type of continuous production line, incorporating both pressure and vacuum forming techniques, was introduced by Plaxall, Inc., Long Island City, N. Y., in 1953. (See "Automatic Sheet Forming," MODERN PLASTICS, *30*, 106, July 1953.)

Today, a number of fabricators have installed automatic forming production lines. One of these, Robinson Mfg., Inc., Coleman, Mich., is doing a particularly outstanding job in continuously turning out formed refrigerator parts.

Four extrusion machines are set up in the Robinson plant—two 4½-in. machines, one 3½-in. machine, and one 2½-in. machine. As high-impact styrene sheet emerges from the extruder (sheet from the 4½-in. extruder is generally about 36 in. wide and 0.090 in. thick), it passes between two metal rollers where a thin-gage transparent oriented styrene sheet feeding off a third roll is laminated to the top surface of the extruded sheet to provide the high one-surface gloss required for refrigerator uses.

The extruded-laminated sheet is then carried forward on a conveyor belt into an oven where a metal female mold suspended over the sheet is lowered onto it and the vacuum is pulled. Automatic equipment then carries the mold forward with the sheet at the same speed at which the sheet is being extruded.

As soon as the mold is clear of the oven, the vacuum is released and the mold returns to the overhead position and is pulled back into the oven, ready to repeat the process.

The formed piece, in the meantime, travels forward on the conveyor belt and is cooled at room temperature. At the end of the line, an operator cuts the formed piece

Courtesy Shaw-Randall Co., Inc.

**Prospects for sheet forming loom large in the packaging of carded merchandise. One method is to enclose items in contoured transparent bubbles; another (below) is . . .**

**. . . "skin packaging," a method in which items are first positioned on adhesive-coated cards. The sheet is then drawn down over the cards to form a virtually invisible protective skin. Another possibility for this method is in . . .**

**. . . the packaging of toys. One manufacturer who previously merchandised his toys in a polyethylene bag (top) now forms an acetate skin package over the toys (bottom)**

off the web with a knife and passes it on to the trimming, die-cutting, and punching operations. Scrap is reground and fed back into the hopper of the extruder.

### Roll Feed

Feeding flexible plastic sheeting off a roll and into the forming machine appears to have a large future in the sheet forming industry, especially in the production of packages in large quantities.

Two manufacturers are already supplying machines that provide for hooking up rolls of plastic sheeting to the back of the machine. Pulling the web forward and clamping it in the frame, however, is still manual.

R. C. Molding, Inc., New Hyde Park, N. Y., for example, uses the roll-feed method for forming a three-dimensional boxing glove for Ideal Toy Co. The glove, which is fabricated of 0.020-in. flexible vinyl sheeting, is heat sealed by Ideal to the fronts of their "Joe Palooka" vinyl inflatables.

With the roll of vinyl on the back of the forming machine, the operator pulls the sheet forward manually and clamps it in the mold frame. The closing of the mold frame cuts the clamped section off from the rest of the roll. After removal of the formed piece, the sheeting is again manually pulled forward from the roll.

Just how soon the principles of automation will be adapted to the roll-feed technique is still a question. Several fabricators claim they are already working on equipment to automatically index the sheet forward after each forming cycle.

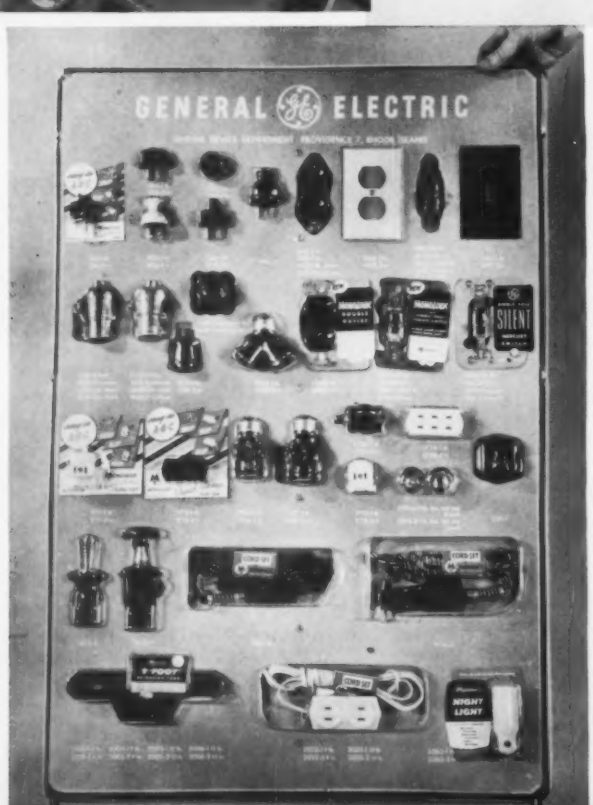
One fabricator has even bigger ideas and is working on the concept of printing a four-color in-distortion pattern on the entire roll of plastic sheeting and then feeding the roll automatically through the forming operations.

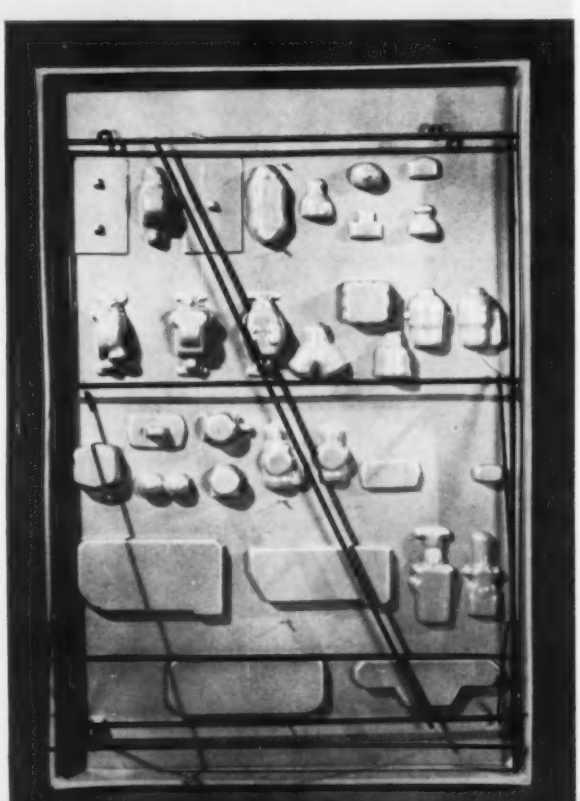
## Materials

The "big four" materials in vacuum and pressure forming are vinyl, styrene, acetate, and butyrate. How much of each makes up the 20 million lb. of material sold last year, however, is a question. Many industry representatives say that the order of listing above is correct as far as poundage sold for sheet forming is concerned; just as many violently disagree. And with improved materials formulations appearing almost daily, the percentage of any one material going into sheet forming is not going to remain static for very long.

### Vinyl Sheet

Calendered rigid vinyl sheet has much to recommend it for many sheet formed applications, particularly its adaptability to the pre-



**Eye-catching display for electrical appliances (below, left) uses the concept of contoured bubbles to advantage. The back of the display (below, right) is formed of styrene to the back contours of the appliances. Each item is then dropped into its proper cavity and a second contoured sheet of transparent acetate is fastened to the front of the display (left)**

printing technique, and it is finding extensive use in displays and signs, translucent lighting panels, and packaging. New markets are in the offing with the recent introduction of a calendered rigid sheet developed expressly for deep-drawn applications.

Considerable interest has also centered on a new method of stamping rigid vinyl sheeting with slightly altered conventional automatic metal stamping presses. A list of the products in which these stampings should find use include such large items as components for washing machines, refrigerators, freezers, and air conditioners; lighting reflectors; food trays; freezer boxes; automotive parts; and closures.

Also finding new areas of application is flexible vinyl sheeting. The use of the flexible materials for wallets, place mats, and various personal accessories is already proved and new ones are cropping up every day—from notebook covers and children's brief cases to upholstery.

### Styrene

High-impact styrene sheet has already established permanent markets for itself in the refrigeration, housewares, toys and novelties, signs and displays, and packaging fields. This year, however, with the introduction of several new extra-high-impact styrene alloys and styrene copolymers, the material is beginning to get a firm grip on those market areas where extraordinary abuse has always been a problem. This would include such applications as action toys; automotive parts; industrial housings; appliance housings; serving trays for air lines; business machine housings; and the housing and components for portable chest respirators. Once the price problem has been overcome, the extra-high-impact styrene sheet will be a factor to be reckoned with.

### Acetate, Butyrate, Acrylic

Major outlets for clear tough acetate sheet in the forming industry are packages, counter displays, and signs. Its market potential in the packaging field is especially high in view of the current merchandising emphasis on "bubble" containers and the new "skin packaging."

**Modernistic room divider incorporating tough, colorful vacuum formed drawers marks one of the first applications of sheet forming to the furniture field**

**Another experimental piece of furniture making use of the light weight and the outstanding strength of the formed drawers is this practical chest for baby's room**

Courtesy Monsanto Chemical Co.

Butyrate sheet is also going primarily into signs and displays and packaging applications. Great hope is held out for a new butyrate sheeting material with excellent resistance to outdoor exposure. The first outdoor signs to be made of this material have already been fabricated and installed. An illuminated sign, produced by Majestic Creations, Inc., Woodside, N. Y., measuring 36 in. high by 30 in. wide and with an over-all depth of more than 15 in., is one example.

The sign consists of two half shells vacuum formed from sheets of 0.090 in. thick butyrate and assembled to an aluminum frame by a lip-and-channel arrangement. A

Courtesy Chanal Plastics

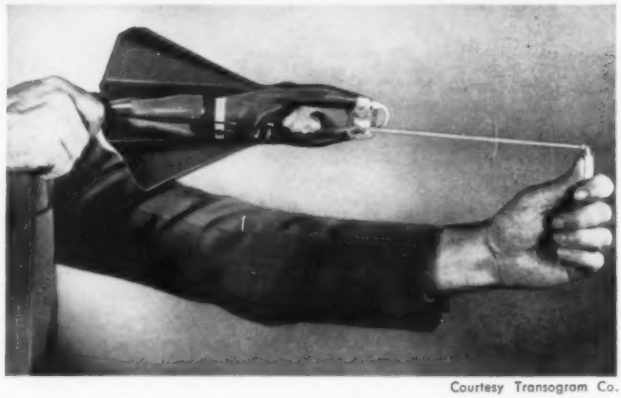
**Wood grain is applied by decal method to styrene sheet before forming**

Courtesy Monsanto Chemical Co.

**Children's face masks vacuum formed of flexible vinyl sheeting faithfully reproduce the most intricate and minute detail**

**Baby shoes package features vinyl base preprinted in color and formed into register; clear top is formed of acetate**

Courtesy Plaxall, Inc.



Courtesy Transogram Co.

**Because of reduction in weight made possible by thin, rugged wall sections of formed styrene figure, toy can be shot long distances through the air**

cameo scene is preprinted in four colors on the face of each of the shells. Over 200 of the signs were installed in 1954 and, to date, there have been no reported failures.

Acrylic sheet is still being primarily formed by the conventional pressure and vacuum snap-back techniques described on p. 88. Main outlets are outdoor signs and lighting fixtures. There has been quite a bit of experimental work going on, however, in adapting the thinner acrylic sheet—⅛ in. thick or less—to commercial vacuum forming for the production of lighting fixtures and diffusers.

## Polyethylene, Polyesters, Vinyl

It is still too early to determine the future of polyethylene in the sheet forming field. Some feel that its applications will be limited; others, and this category seems to be in the majority, herald it as the most promising of all. Its possibilities are only now being explored, particularly in the packaging field where its advantages are already well known and recognized. From Canada comes news of a vacuum formed polyethylene container (see p. 213) regarded as the forerunner of a whole new concept in the packaging of perishable foods.

It is also interesting to note that irradiated polyethylene sheet (polyethylene that has been bombarded with electrons from a high-energy source), has much to recommend it for formed applications. When irradiated polyethylene sheet is heated above a temperature of 240° F., it is transformed into an elastic material. (See "Applications of Irradiated Polyethylene," MODERN PLASTICS *32*, 103, March 1955.) Consequently, in vacuum forming, very deep draws are possible with relatively little temperature control. According to one supplier of irradiated polyethylene, markets open to the material will be in such equipment as containers and trays for the chemical and allied process industries where chemical resistance is required along with toughness and the ability to be sterilized. Forming irradiated polyethylene sheet into housings for equipment that has to be used in corrosive atmospheres also promises to be an interesting application.

One other material mentioned as a candidate for the sheet forming process is Mylar polyester film. There has been some activity with this material in recent months, but most of it has been developmental and no definite conclusions have been reached as to suitable applications.

Another unusual variation in materials usage is the idea of using a cast vinyl plastisol sheet for form-

ing doll faces. Traditionally, on low-cost dolls of this type, the face is either formed of styrene copolymer sheet or slush molded of vinyl plastisol. Sam Richman Co., New York, N. Y., who is developing the new method, claims that once the few remaining fabrication problems have been licked, many economies will be gained. Although the initial cost of the sheet is high, the company maintains that savings on labor costs, faster rates of production, and low tooling costs make the operation practical. Approximately 18 to 20 faces can be formed at a time on a 27- by 20-in. sheet, 0.060 in. thick.

## Applications

Formed sheet applications already in use range from tiny packages measuring ¼ in. in width to huge displays standing 6 ft. high. Although the techniques are considered to be still in their infancy, sheet formed products are already an important part of many industries. And despite the million-unit production figures that crop up frequently, markets are nowhere near saturation. Many of the already established markets show plenty of room for expansion; just as many, as yet virtually untapped, are ripe for exploitation.

### Furniture Drawers

As might be expected with any new method, the first three or four years in which vacuum and pressure forming processes were gaining popularity, major emphasis was on adopting the technique to the production of conventional products conventionally designed. Today, the emphasis has changed. In recent months, a number of applications have appeared in which the properties of the plastic sheet and the design advantages of the forming methods have been allowed to suggest final form and function. Typical of this thinking is the job done by Monsanto Chemical Co. and Pratt Institute's Industrial School of Design with a modernistic line of furniture designed around vacuum formed styrene drawers and shelves.

The formed drawers differ from conventional units in that they have rounded corners and are ribbed across the bottom for greater strength. Matching the dramatic simplicity of these drawers called for styling an entirely new and revolutionary line of furniture.

### Packaging

A similar attitude toward sheet forming has been found in the packaging field. One major packager estimates that there has been a 500% increase in his production of formed plastic sheet packages within the past 12 months. Another company currently using some 25,000 formed bubble packages annually for each of the 20 plumbing items in its line predicts that volume will be increased to between 400,000 and one million units per item by 1958. And still another manufacturer who formerly sold 200,000 specialty notions items a year credits the formed package with upping production to 100,000 units a month.

Developments in packaging range along a wide front. Four basic areas, however, are worthy of individual mention.

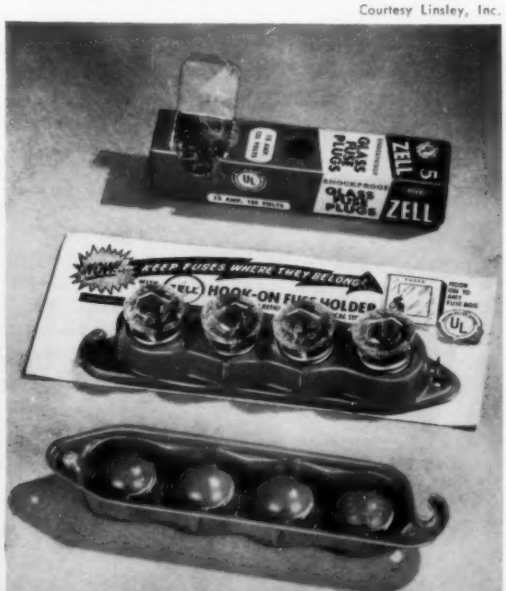
**1) "Bubble" and "Skin" Packaging**—The constantly increasing trend to retail self-service in every field from food to hardware has resulted in radical packaging changes. With the accent more and more on impulse buying, carded merchandise has won a secure place for itself on

(*To page* 212)

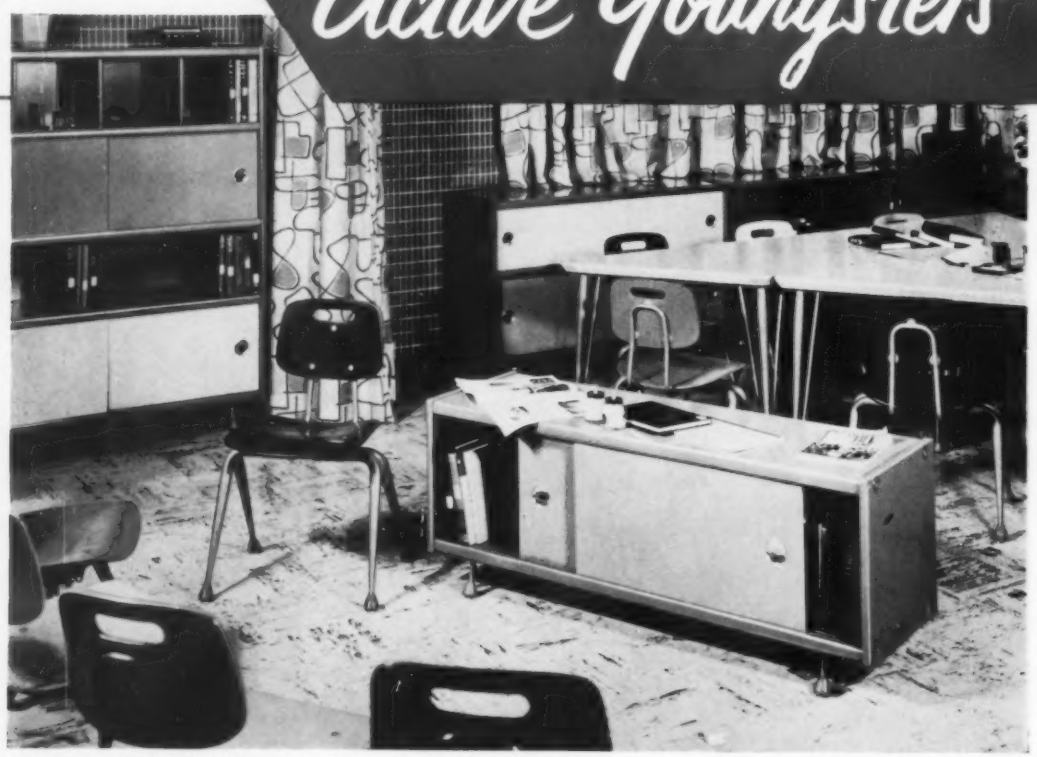
Courtesy Eastman Chemical Products, Inc.
**Weather resistance of butyrate sheet is ideal for formed outdoor signs**

**Sheet forming is as adaptable to deep drawn trays and displays (top) as to shallow packages (foreground)**
Courtesy Vacuum Molding, Inc.

**Cardboard box for fuses (top) was supplanted by formed styrene unit that can be conveniently hung on fuse box**
Courtesy Linsley, Inc.



# Designed for *Active Youngsters*



Courtesy Brunswick-Balke-Collender Co.

**Bright cabinets with top work surfaces of melamine laminate, and chairs with reinforced plastics backs and plastic-bonded plywood seats add to cheerfulness of classroom. In addition, furniture is rugged enough to withstand constant onslaught of eager students**

THE little red schoolhouse—or, rather, its modern counterpart—is learning about plastics. More specifically, fibrous glass reinforced laminates and melamine-surfaced laminates are finding greatly increased usage in school furniture, which must meet tough performance standards to withstand the challenge of active youngsters.

The entrance of plastics into this field, long dominated by wood and cast iron, presages a new era of comfort, color, and service-ability for school furniture. It is welcomed not only by students and teachers, who use the furniture, but also by school authorities (who like the reduced maintenance requirements) and by taxpayers (who ultimately foot the bills).

At least two large manufacturers of school furniture and public seating are now producing new lines in which plastics play an important part. One of these is Shwayder Brothers, Inc., world's largest producer of luggage and folding furniture, which has just announced a large new line of classroom furniture styled by Russel Wright. The other is Brunswick-Balke-Collender Co., which recently brought out a modernly styled line.

The new Shwayder Samsonite school furniture line embraces a total of 160 pieces, including students' and teachers' chairs and desks, activity tables, etc., in a variety of sizes and styles. Exhaustive studies were made in more than 30 states to ascertain the needs in classroom furniture before the line was developed. A major problem, as pointed out by Russel Wright, the designer, was that of staying within the rather strict specifications set forth for school furniture and still coming up with items having a fresh design approach and new functional features.

"The furniture," says Mr. Wright, "is in keeping with progressive educational methods and our aim has been to provide a more reassuring atmosphere for the child than the static regimentation of the brown cast iron and bolted-down furniture in use in our classrooms for generations. The innovations I've made have been along the lines of more comfort, a more organic and flexible use of the classroom, and a friendlier environment for the child."

Based on considerable research, pale cocoa brown was chosen as the principal color in which the line will

New schoolroom furniture takes full advantage of the durability, strength, and unlimited color possibilities inherent in reinforced plastics and melamine-surfaced laminates

A far cry from the confining desk-chair combination found in traditional classrooms, modern student chair has reinforced plastics backrest that adjusts easily to fit the posture of the student —no matter how squirmy—and seats of plastic-bonded plywood that are contoured for solid seating comfort

Courtesy Shwayder Bros., Inc.

be manufactured. In addition, the various pieces will be available in a neutral grey, red, and turquoise. It is Mr. Wright's contention that although much had been done in recent years to brighten the appearance of schoolrooms by means of attractive wall treatments, school furniture had not kept pace.

### Contoured Backrest

A feature of the new Samsonite school chairs, made in several sizes and available both with and without attached writing surfaces, is the use of a contoured backrest, molded of fibrous glass-polyester material with a metallic grey color directly in the resin, which not only provides comfortable support, but is so mounted that it automatically adapts itself to students of different height and build. "There has never been a chair," declares Mr. Wright, "which not only fits the contours of their bodies but adapts to the squirminess of the kids." The plastic back supports, which are attached to a metal backing and mounted to the tubular steel structure of the chairs by means of a hinge which permits them to shift for a conforming fit, eliminate problems of refinishing, keeping their original smart appearance through long service.

"I have provided a plastic contour-fitting, adjustable back," adds Mr. Wright, "because I can still remember how those stiff unmovable backs felt on my scrawny anatomy and I know what a terrific help my adjustable posture chair is at my drawing board."

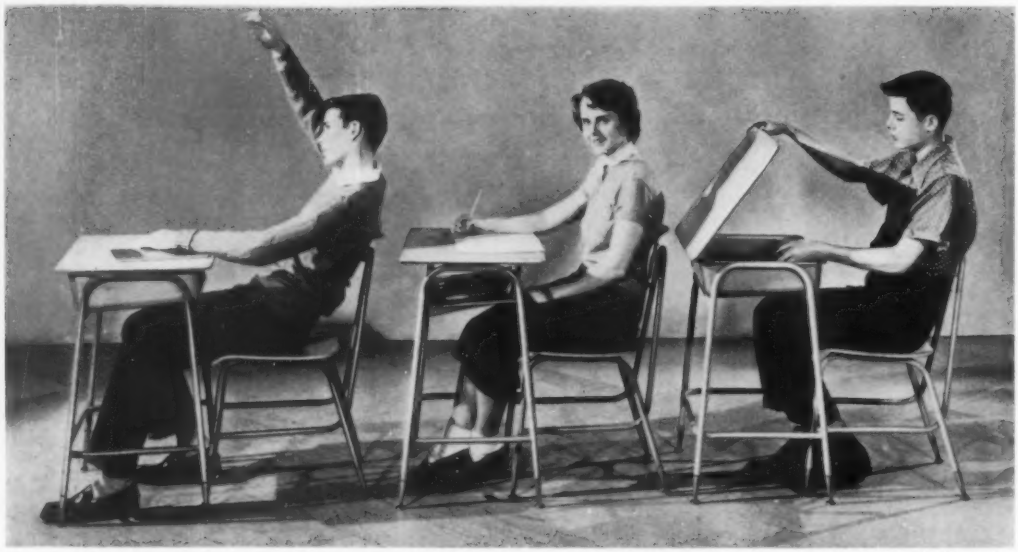
The contoured seats of the new Samsonite classroom chairs are of plastic-bonded plywood. Chairs may be stacked for storage or clearing of classroom for exercises. Pivoting stainless steel glides, also used on the desks, provide a self-leveling feature and also permit the chairs to be shifted around the room easily without floor damage. A hand grip at the back permits easy carrying.

Desk and table surfaces in the new Samsonite classroom furniture are offered in a choice of three materials: plastic laminated to plywood, solid maple or birch, or maple plywood. The melamine tops, in particular, feature ease of cleaning; a hard, smooth writing surface that is virtually stainproof; and authentic wood grain patterns if desired. The durable plastic surfaces are expected to do away with one of the oldest complaints concerning wooden desk tops—the fact that they constituted an ideal medium for amateur carving, lettering, and art work.

Plastics also play an important role in the construction of the new Brunswick school furniture, where they help to keep the various pieces as completely functional as possible for the needs of today's classrooms.

### Stacking Chairs

Brunswick's most colorful use of plastics is in its fibrous glass-polyester stacking chair which is produced in three colors—tangerine,



Courtesy Shwayder Bros., Inc.

**New line of classroom furniture includes three desk types (left to right): open-front book box, open shelf, and lid-lift type with adjustable friction hinge. Desks as well as chairs have been designed for optimum physical and emotional comfort of student**

beige, and green. This unit is nearly identical to the regular Brunswick stacking chair except that the plastic laminate is used for the seats and backs instead of plywood. Both types of seats are compound-curved for maximum comfort.

The new Brunswick reinforced plastic chairs, available in 17- and 18-in. sizes, have been found ideal for school cafeterias, where they can be wiped clean in a jiffy, or for lounges, where their color is a desirable decorative aspect. In addition, they are being used in hospitals, institutions, and business establishments because of their ideal combination of colorful appearance, functional comfort, and the cleanliness of the reinforced plastic seats and backs.

## Durable Work Surfaces

Less apparent but no less important is the use of a durable plastic work surface for Brunwick's students' desks, teachers' desks, tables, and cabinets. All these units are available with a melamine sheet on the top surface to provide the utmost in durability and cleaning ease. The advantages of a plastic surfaced student desk are obvious. Though not usually subjected to equally hard usage, the teachers' desks, tables and cabinets also become more serviceable because of melamine work surfaces.

Through such usage of modern plastic materials in school furniture, students may now enjoy many of the functional and decorative advantages formerly confined to the furniture used by adults in offices and homes.

**Teacher has not been forgotten in furnishing modern school room. Single-pedestal desk is available with melamine top**

**Table suitable for various classroom group projects is available with top of melamine laminate in a range of sizes and in a variety of colors**

Courtesy Shwayder Bros., Inc.

# PLASTICS PLANETARIUM

Courtesy Toy Guidance Council, Inc.

**Light from bulb inside miniature planetarium passes through tiny holes in vacuum formed butyrate globe to project replicas of constellations onto ceiling and walls**

THE newest techniques in plastics fabrication have been put to use in the design of a miniature planetarium that is expected to stimulate children's and adults' interest in one of the oldest sciences in the world—astronomy.

As created by Armand Spitz of Spitz Laboratories, Philadelphia, Pa., and marketed by Harmonic Reed Corp., Rosemont, Pa., the planetarium consists of a globe made up of two vacuum formed butyrate hemispheres and rotating on a metal axle set into a molded styrene base. Using a special die cutting technique, over 300 holes are punched into the globe, each one representing a corresponding star in the sky.

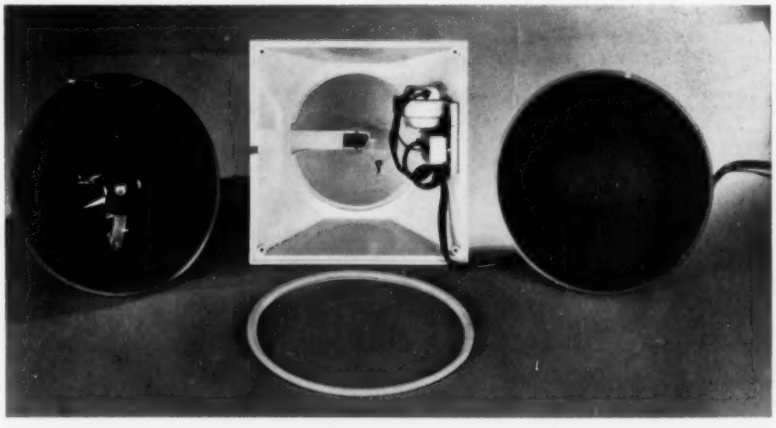
When the planetarium is set in the center of a darkened room and plugged in, light passes through these holes, projecting a miniature, but accurate replica of the stars in the heavens onto the ceilings and walls of the room. By rotating the globe on its axle and by swinging the axle up and down to change the angle of elevation of the globe, the position of the stars can be set for any latitude or time of year.

The hemispheres that are joined together to make up the globe are vacuum formed 21 at a time from a sheet of butyrate, 0.040 in. thick and measuring 21 by 51 inches. After forming, each of the translucent hemispheres is individually cut out of the sheet, leaving only an extending flange running around the circumference of the bottom edge, and each hemisphere is then spray-painted on the inside surface with an opaque blue paint.

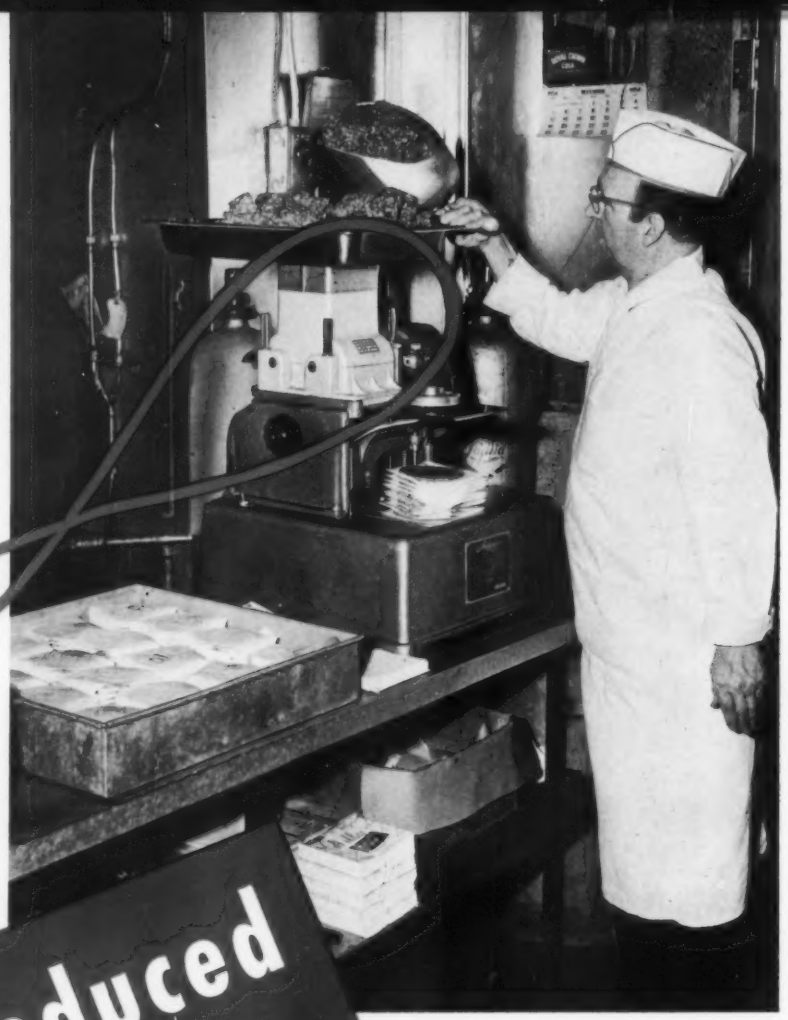
The metal axle, light bulb, and necessary electrical connections are then slipped into a circular opening die cut into the dome of the hemisphere that is to serve as the bottom half of the globe. The other end of the axle is passed through a narrow slot molded into the top of the hollow styrene base and then into a molded-in seat. Two projecting pins at the foot of the axle slide into two notches molded into the opposite walls of the seat, enabling the axle to swing freely up and down in the slot. To facilitate setting the globe for an exact latitude, depressed calibrations are molded into either side of the slot. The base is molded of high-impact styrene in a single-cavity mold on a 12-oz. press.

As a final assembly step, a molded butyrate disk which slides over the metal axle is cemented to the bottom hemisphere at a point where the axle passes through the opening. Molded butyrate control knobs are then fastened to the face of the styrene base and the two hemispheres are securely joined together by matching up both of their extending flanges and snapping a yellow rubber ring over them.

CREDITS: Hemispheres vacuum formed by Pearson-Berlinghof, Inc., Newtown, Pa., using butyrate sheet supplied by Eastman Chemical Products, Inc. Eastman also supplies butyrate for component disk, knobs, etc. Base is molded by Harmonic Reed Corp., Rosemont, Pa., using No. 475 high-impact styrene supplied by The Dow Chemical Co. Mold for the base was built by Liberty Tool Co., Irvington, N. J.



**Planetarium globe is produced by joining butyrate hemispheres with rubber ring (foreground); opening in styrene base (center) accommodates axle to which globe is attached**



Ground meat is loaded into hopper feed tray of automatic meat patty machine. The hopper itself (top and bottom sections and gear-driven compressor), previously made of aluminum, is now molded of fibrous glass-reinforced polyester—at substantial savings in production and maintenance costs. While the feed tray in the picture is of stainless steel, plans have been made to switch to reinforced plastics for this component as well

# Cost Reduced $15 per Unit

## Manufacturer of food handling machine switches from aluminum to reinforced plastics, with savings all along the line from parts production to maintenance

FOUR essential components of the Hollymatic electric steak and patty forming machine, a heavy-duty unit capable of turning out as many as 2100 raw meat patties per hr., have been switched from cast aluminum to a new high-strength reinforced plastics molding compound composed of precatalyzed, colored polyester resins and chopped strands of fibrous glass.

By redesigning the hopper parts from cast aluminum to the new reinforced polyester molding compound, the manufacturer has greatly improved production flow, increased the efficiency of the machine, minimized operating breakdowns and repairs, and reduced labor and material costs more than $15 per unit.

Officials of Hollymatic Corp., Chicago, Ill., producer of the machine, are so well pleased with the economy and superior features of the new plastics parts that tooling is now in progress on another major component—the hopper feed tray—which will replace the present stainless steel part.

The function of the Hollymatic machine, originally placed on the market in the 1930's and progressively improved through the years, is to form hamburger and other ground meats into patties of uniform size and weight, providing accurate portion.

### Compression Molded Parts

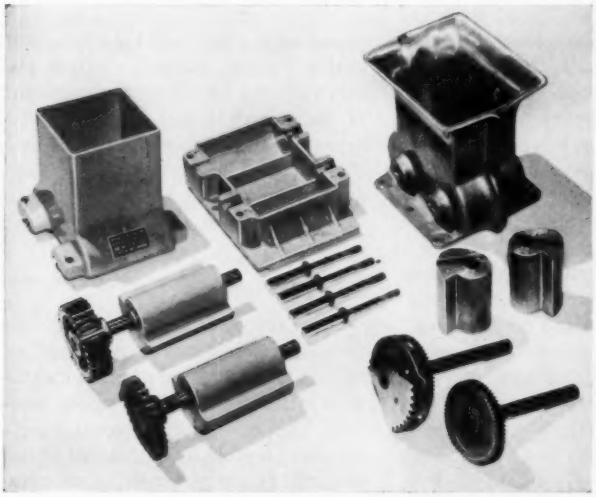
The new compression molded plastic parts include hopper top and bottom sections and the gear-driven compressors, which are cam-like rollers that force the ground meat out the bottom of the hopper through

a reciprocating metal mold plate. The thickness and shape of each patty are determined by the thickness of the plate and the design of the opening in it—round, square, or "chop" shape. Plates are readily interchangeable according to the user's requirements. After each patty is formed, the mold plate moves forward and the meat is automatically ejected from the opening by a knockout ring, falling on the stack and separated from the previous patty by a square of waxed paper.

Particularly interesting from the production standpoint is the fact that the molded plastics parts require only minor finishing operations in addition to one simple milling operation prior to final assembly. By way of comparison, the corresponding cast aluminum parts had to be put through a succession of costly finishing operations.

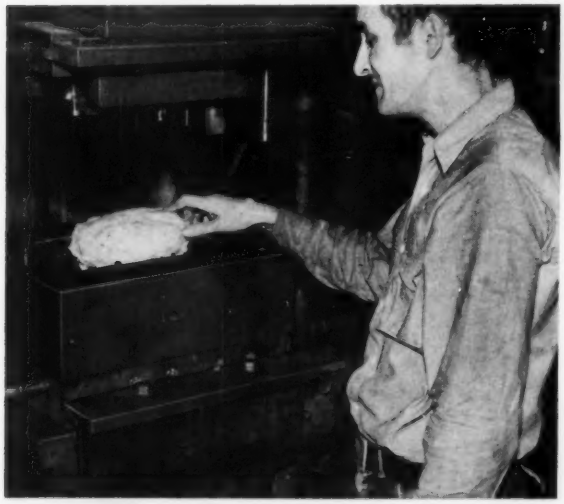
Furthermore, if the aluminum hoppers were accidentally dropped, they were subject to denting or deforming which might interfere with the close fit of the compressors or prevent them from turning freely.

Thanks to the two-piece design of the new plastic hopper with its simplified split bearing arrangement, both assembly and cleaning of the entire hopper assembly have been made much more convenient. With the removal of the four hopper bolts, the entire upper section of this unit may be lifted off, making the compressors and the bottom part of the hopper completely accessible. The plastic parts may then be conveniently cleaned after each day's usage. The heavy-duty plastic hopper sections are not easily damaged by dropping or similar mishaps. Their ruggedness greatly reduces the servicing problem and cuts maintenance costs for the user. The compressors, molded directly on the



Replacing aluminum parts (right) with reinforced plastics hopper components (left and center) eliminates numerous fabricating operation

1 In first step in molding bottom hopper section, operator weighs charge of molding material by balancing against finished part



2 Weighed molding material is placed in mold mounted on a 300-ton compression press; molding cycle is approximately six minutes

3 At end of cycle, part is removed from chrome-plated mold and rough flash removed; part will then be placed on a shrink fixture

metal shafts, form permanent, trouble-free units.

In seeking a plastic material which would facilitate production and reduce manufacturing costs, at the same time insuring improved operation and simplified maintenance of the patty machine, Hollymatic officials studied the problems involved with a midwestern compression molder. Because of the heavy service requirements of this meat processing device, plus the need for very high dimensional stability and the heavy wall sections required, several types of thermosetting materials were investigated. The material ultimately selected is a putty-like mixture of precatalyzed polyester resins and chopped glass fiber strands, adaptable for moderate-pressure compression, transfer, or plunger molding. The light tan color used harmonizes well with the metal parts of the machine and eliminates any need for surface finishing of the hopper.

Among the factors leading to selection of this molding material were its excellent flow characteristics and conformance to the hopper's complex curves, angles, and deep draws, with uniform distribution of the glass reinforcement for required strength at all points. Other features of this material include its combination of low weight with great strength, resistance to corrosion or staining by meat fluids, and the fact that the plastic is odorless, tasteless, and non-toxic. Its use for the patty machine parts received the approval of the Bureau of Animal Industry, U. S. Department of Agriculture.

## Molds and Molding

The plastic parts for this machine are produced in three separate molds, including two of single-cavity construction and a two-cavity mold which turns out a matched pair of compressors at each cycle. Subsequent operations in the molder's plant are limited to conventional removal of flash.

The hopper bottom, measuring approximately 9½ by 7½ by 2½ in. deep and having a finished weight of just under 4¼ lb., is flat on the bottom surface and has a rectangular slot 3½ in. wide, by way of which the ground meat is forced through the mold plate opening as the compressors turn. On its inside or top surface, this part is divided into three sections by heavy ribs. At each side of the two outer sections are semi-circular grooves in which the compressor shafts rotate about one-half turn, then reverse direction to allow more meat to move into position for the next stroke. The shape of the two end chambers is designed for a close fit with the compressors. The other half of the shaft bearings is on the bottom of the upper hopper section.

The hopper bottom is molded on a 300-ton compression press. The mold is chromium-plated, as are the two others used on this job. This part is molded with the cavity mounted face-upward in the press so that the weighed charge of molding material can be placed directly in the cavity. The press operator makes up chunks of the molding material prior to each press cycle, using a balance scale and checking the charge against the weight of a finished part to make certain the mold will be adequately filled. Because the bottom surface of this part must be made in four different thicknesses to accommodate various patty mold plates, the punch is made with a removable end section which can be changed to vary this dimension.

Opening the press, the operator places the charge of molding material, weighing approximately 4½ lb., in the cavity. The press is then closed on low pressure only for about half a minute, partially setting the material and preventing entrapment of gas which might cause burned areas on the finished piece. The full 300-ton molding pressure is then applied for the duration of the molding cycle, which requires about six minutes.

## Shrink Fixtures

Upon removal from the mold, the part receives preliminary flashing and is placed on a shrink fixture with a heavy weight on the flat surface. This operation prevents warpage and possible misalignment of the bearing grooves, which must mate perfectly with those on the upper

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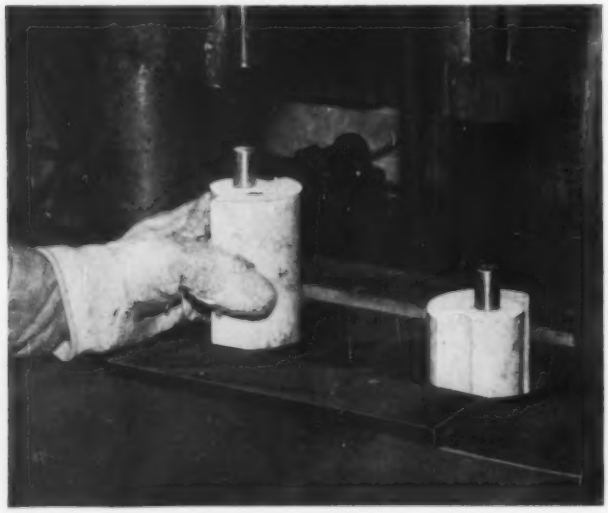
Cam-like compressors are produced in two-cavity mold on a 250-ton press. Steel shafts stand upright in cavities and material is molded around them



Brief milling operation brings base section of hopper to final height and insures fit between top and bottom of split bearings

# Transistor Radio in Styrene Case

Mass-produced portable transistor radio, small enough to fit easily into pocket or handbag, is housed in attractive case molded of colored styrene

HOUSED in a smartly designed molded styrene case smaller than a postcard, and tipping the scale at less than 12 oz., the Regency Model TR-1 is said to be the first commercially produced pocket radio utilizing transistors instead of tubes. It also embodies a printed circuit on phenolic laminate stock for compact construction and elimination of most "trouble-spot" connections found in conventionally wired chassis.

The Regency is a product of Industrial Development Engineering Associates (I.D.E.A.), Indianapolis, Ind., manufacturer of high fidelity sound equipment and television accessories. Measuring only 3 by 5 by 1¼ in., the superheterodyne unit is powered by a single miniature 22½-v. battery, receives all standard broadcast stations plus civil defense bands, has excellent range and volume, and will operate for approximately 20 hr. of playing time on one battery. Much of the success of the Regency radio is attributed to the development of a high-performance, low-cost transistor by Texas Instruments, Inc., Dallas, Tex.

The jewel-like plastic case of the radio was styled by the Chicago design firm of Painter, Teague, and Petertil. Molded of medium-impact styrene in grey, red, ivory, and black, the case is made in front and back halves which snap securely together. The two halves of the case are molded with mating internal ledges which insure a close fit. In addition, four small lugs on the front half of the case snap into matching recesses in the rear half.

The front side of the case has a round core for the shaft of the station selector dial and a beveled slot which accommodates a sector of the rotary volume control knob, also molded of styrene. More than half of the front surface of the case is covered by the 225 round openings which comprise the speaker grille. The back half of the housing has a side opening near the top through which an accessory earphone cord may be plugged in when private reception is desired.

Pocket-size radio with back of case removed. Lugs and notches on the two halves of case mate to assure close fit. Supplementary earphone (left) comes in its own styrene box

All plastic parts for the Regency radio are molded on a 5-oz. injection machine. The two halves of the case are produced in a two-cavity mold which has one side-core for the earphone plug opening, as well as retractable bars which form the interlocking lugs and recesses. The action of these movable portions of the mold is controlled by the knock-out plate.

Exacting dimensional tolerances are met by running the case on a fairly long molding cycle and maintaining close mold temperature control. To avoid difficulty in removing the case from the mold, approximately 65 knock-out pins are used to uniformly distribute the ejection pressure around the intricate grille openings.

CREDITS: Case parts molded by Argus Plastics, Indianapolis, Ind., using Dow and Monsanto medium-impact styrene.

# Vinyl-Metal TV Cabinets

**Laminate reaches consumer market after being proved in business-machine housings; other fields loom**

Photos courtesy CBS-Columbia

**Scuff-resistant cabinet of 21-in. table model television receiver is fabricated of vinyl-metal laminate. Use of vinyl makes a range of decorative cabinet colors possible**

VINYL-METAL laminates, a new type of structural material having a number of interesting properties, are now beginning to reach the consumer market in attractively styled, scuff-resistant television cabinets offered in a choice of four colors. CBS-Columbia is utilizing this material for its new Century series of 21-inch table model sets, cabinet dimensions of which are 18½ in. high, 21½ in. wide, and 20½ in. deep.

These sets mark the first use of this type of material in the home furnishings field. It made its initial commercial appearance in the housing of the new IBM bank proof machine (MODERN PLASTICS *31*, p. 107, May 1954), and is expected to find extensive use in air conditioner cabinets and similar types of products.

Called Dura-Clad by the set manufacturing division of the Columbia Broadcasting System, the plastic-metal combination retains the strength of metal, yet offers the full, rich colors available in vinyl sheet material and requires no special maintenance or "pampering" of the durable plastic finish. The material, developed by O'Sullivan Rubber Corp., Winchester, Va., under the tradename of Sullvyne-Clad, is being manufactured for CBS-Columbia by O'Sullivan.

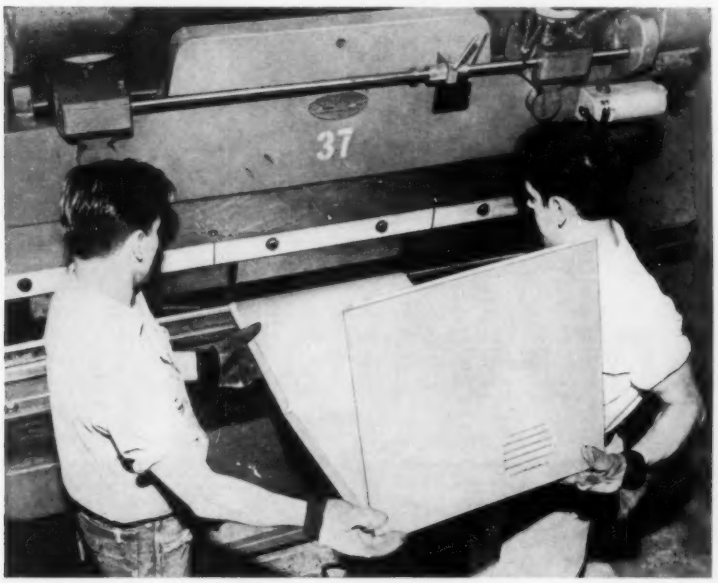
In its advertising for these new models, incorporating "Sweep Tuning," CBS-Columbia is highlighting

the new plastic-metal cabinet as one of the demonstrable features of the sets. The finish, offered in cordovan, coffee, sand, and grey colors, will not chip, crack, stain, peel, or scratch, and never needs waxing or polishing. Its thin section helps to make possible the compactness of the cabinets, which enclose a space-saving vertical chassis.

The basic laminate is produced in a continuous process by rolling rigid or semi-rigid vinyl sheeting onto adhesive-coated metal sheets or strips. After rolling, adhesion is effected in seconds under heat lamps or other suitable heat sources. Tests on the finished laminate indicate an adhesion in excess of 40 p.s.i., the bond strength being a function of the vinyl covering. This high adhesion permits the material to be fabricated with all types of regular metal-working equipment without damage to the coating. The bond is sufficiently strong to permit 180-degree bends and deep draws; the laminate can also be sheared, drilled, or punched without chipping.

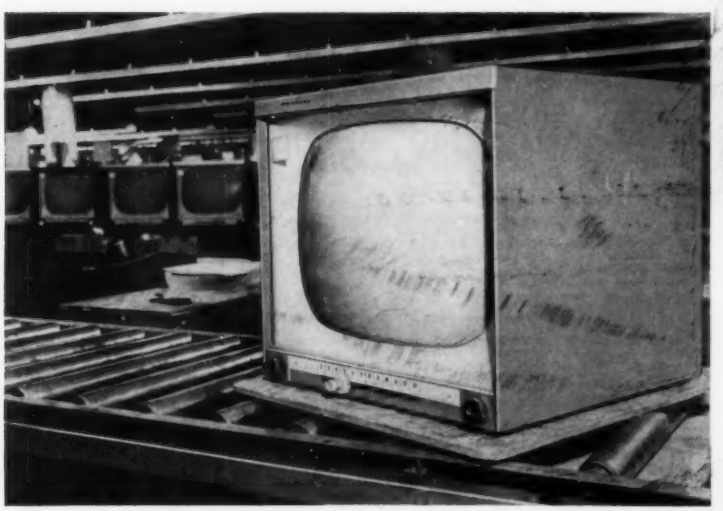
Advantages of the new vinyl-metal laminate cabinets, according to CBS-Columbia, include a decided saving in shipping costs. O'Sullivan Rubber Co. ships CBS-Columbia flat sheets of the material, precut and squared to specified size. It is then readily converted into the finished cabinets by means of several simple bending operations. Normal factory handling of the Dura-Clad cabinets also eliminates the need for the usual "touching up" of bruises, common to wood-finished cabinets.

The top and both sides of the new CBS-Columbia cabinets are formed from a single sheet of the vinyl-metal laminate. To facilitate fabrication, the material is notched out at the edges where folds occur. Bottom edges of the sheet are folded under to permit attachment to the base of the cabinet, and the back edge is turned to provide a smooth, finished surface. Three brackets along the top front edge provide attachment of the cabinet front with its picture tube escutcheon, along with the safety glass tube window.



Top and sides of cabinet are formed in one piece from flat, precut laminate sheet by means of a series of bending operations on standard metal fabricating equipment

TV set is assembled by placing cabinet shell over vertical chassis. Turned-under flanges provide means for attachment, brackets join top and front parts

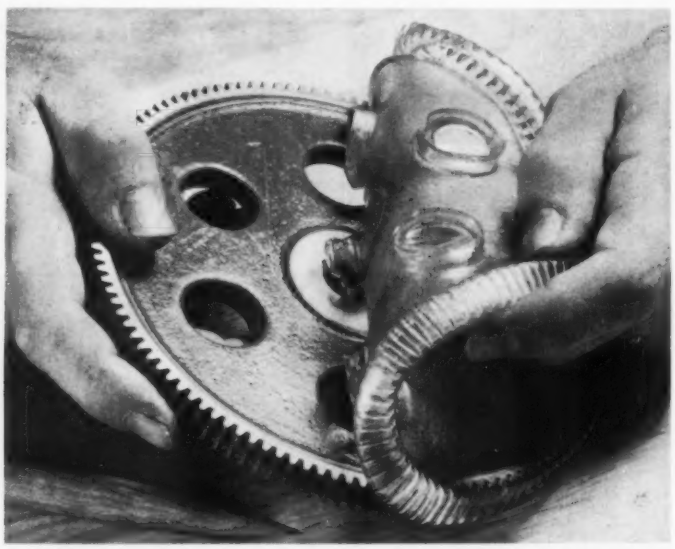


Television set with vinyl-metal cabinet rolls off production line. Unlike receivers with wooden cabinets, no touching up of "bruises" is necessary

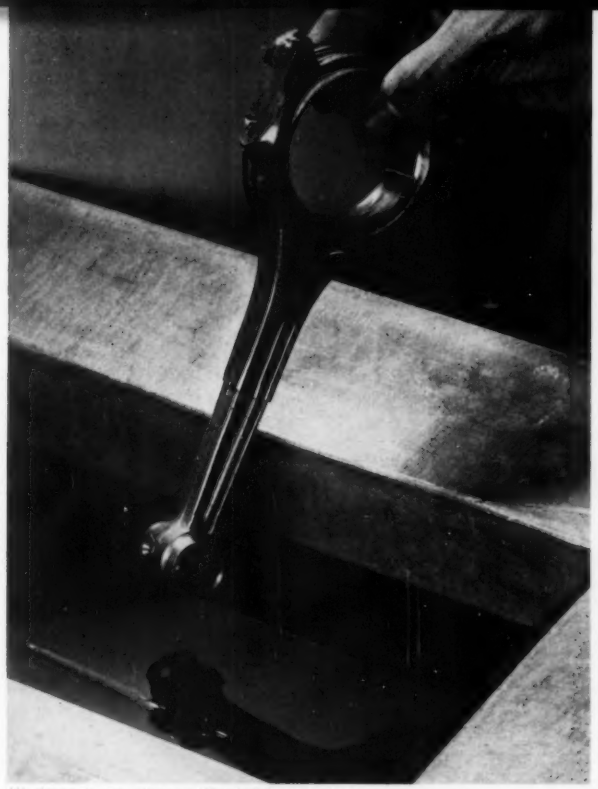
Protective coating for precision gear is applied by dipping the part into molten butyrate compound. After dip, the string by which the gear is held is clipped off where it protrudes through the coating

# Dip for Protection ...Strip for Action

The tough, skin-tight butyrate film remains on the gear during shipment and storage. When ready to be removed, the film—usually ranging from 0.05 to 0.10 in. in thickness—is slit open with a pointed stick or similar sharp instrument



After it has been cut open, the coating is peeled away as one might peel off the skin of a banana. The gear is now immediately ready for use—no cleaning, depreserving, or other operations are necessary. Upon removal, the protective butyrate envelope itself can be melted down and reused over and over again



With multiple-dip method, no string is necessary. The part is simply held at one end while the other end is submerged in the molten butyrate. When the coated end has cooled for approximately one minute, the uncoated end is immersed to overlap the first coat by one inch

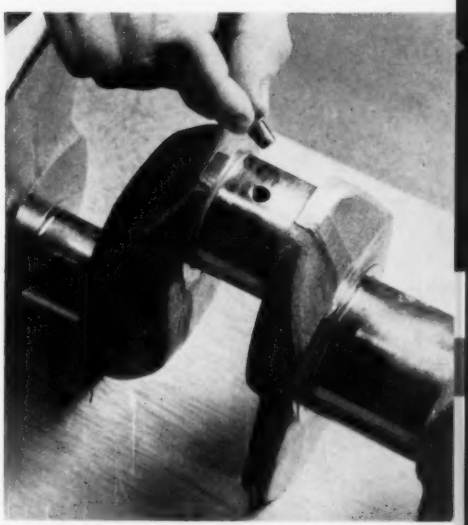
# Peelable butyrate coatings find growing use as protective wrappers for valuable tools, gages, and component parts

All photos courtesy Eastman Chemical Products, Inc.

HAVING been adequately proved during wartime as a protective coating to prevent corrosion of metal parts even under conditions of severe exposure during shipment and storage, peelable butyrate is now making its way into a wide range of peacetime packaging applications.

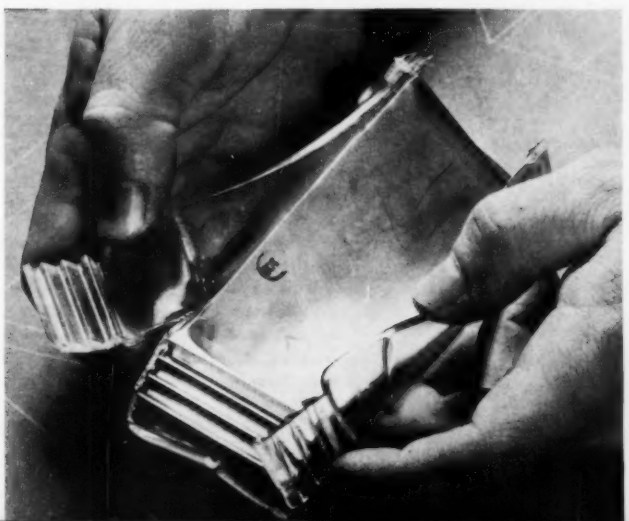
Basically, the peelable butyrate is a compound of cellulose acetate butyrate, dioctyl phthalate, and a rust inhibiting oil. It is available commercially in the form of solid blocks which are made liquid simply by heating to about 350°F. in a melt tank with thermostatic control. The plastic, at this point, becomes a thick syrupy liquid, into which the product to be protected is dipped (see accompanying illustrations). A single dip leaves a tough, skin-tight film, ranging from 0.05 to 0.10 in. in thickness, over the entire surface of the part that has been dipped.

When the plastic protective coating is no longer needed, the film is

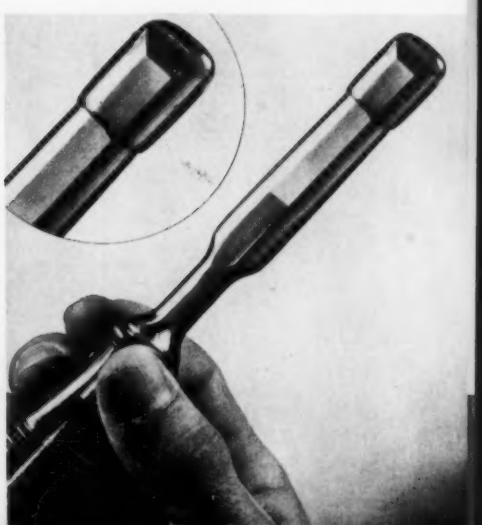


Oil holes and small openings in tools are sealed with molded polyethylene plugs before the dipping operation

When shipped in peelable butyrate overcoats, even high precision parts, such as this blade for a jet turbine, can be handled without fear of scratching or doing other damage that might be cause for later rejection



Sharp cutting edge of chisel is double-dipped in butyrate (inset) as an added safety measure during handling



easily slit with a pointed stick or other implement that will not damage the packaged part and is then removed with no more difficulty than is experienced in peeling a banana.

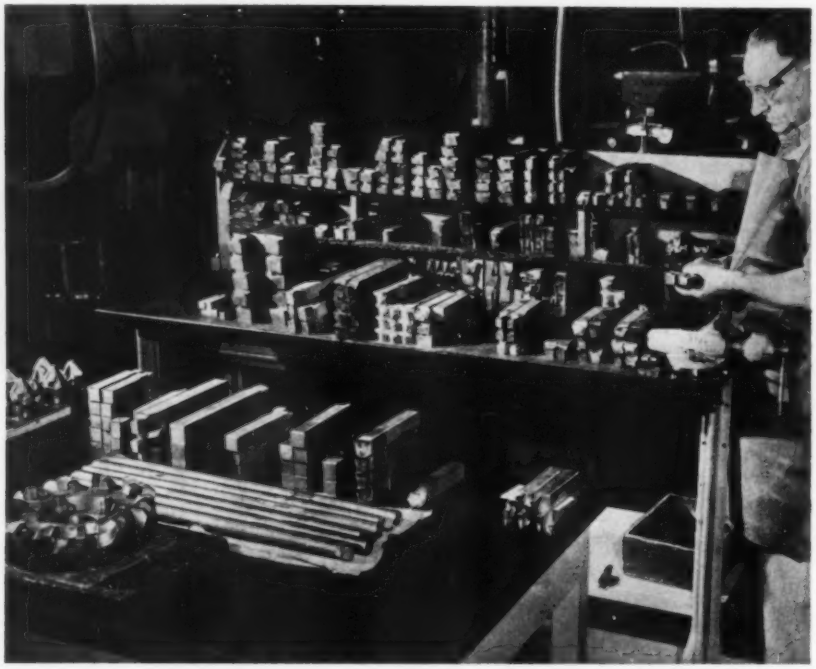
Today, manufacturers of precision tools, dies, castings, component parts, and small sub-assemblies are finding extensive use for the butyrate coatings in the shipment and storage of parts. Once applied, the coatings provide a high degree of protection against abrasion, corrosion, contamination, and tampering. And the protection is complete — no further wrapping is necessary and, in most cases, no labeling, since identifying marks on the packaged part are visible through the transparent coating.

An additional advantage is inherent in the fact that after the coating has been peeled off, no cleaning, depreserving, or other operations are necessary before the part is ready for use. And since the coating itself undergoes no chemical change, it can be melted after each application and re-used over and over again as an easy-to-handle, skin-tight protective wrapper.

CREDITS: Butyrate for peelable coatings is supplied by Eastman Chemical Products, Inc., Kingsport, Tenn.

# Coating Sharp-Edged Tools

One of the 18,000 single-point cutting tools handled weekly in machining operations at Carrier Corp.'s plants is dipped into molten butyrate to protect it from damage until it is ready to be used again. The tank—one of five installed by the company—is maintained at a uniform 350° F. temperature to keep the plastic liquified



Prior to being dipped in the hot butyrate melt, each of the tools—ranging from single point tools to multiple flute units—is inspected for wear and, if needed, is reground to specifications. The operator at the other end receiving the coated tool is thus insured it is ready to be used. The former time-consuming method of wrapping the tool in masking tape was unable to offer a similar high degree of protection and necessitated the extra expense of thousands of dollars to regrind tools damaged in handling or storage

All photos courtesy Eastman Chemical Products, Inc.

Sharp-toothed cutter is included among the over $1 million worth of tools dip-coated at Carrier's plants. Coating is applied in this case by holding the cutter half-immersed in the hot liquid butyrate and slowly revolving it. Since only the cutter-teeth need protection, full immersion isn't necessary. In addition to its cutting tools, Carrier uses the peelable butyrate coating to protect gages and micrometers from corrosion caused by humidity conditions

# Seal-Packaging Electrical Connectors

In-plant assembly line at Brundy Engineering Co., Inc., Norwalk, Conn., takes advantage of the properties of peelable butyrate in the mass production packaging of small electrical connectors for wires and cables. The coating serves primarily to seal in an insulating compound mechanically injected into the connectors prior to the dipping operation. To facilitate handling, the connectors, after being injected with compound, are lined up in groups in specially designed jigs

Securely held in the jig, the connectors are first dipped into a tank containing orange-colored molten butyrate. The jig is then reversed and the opposite ends of the connectors are dipped into a tank containing blue-colored butyrate. Both ends of the connectors are thus effectively color-coded as to size and function for easier identification at time of installation

After the dipping operations, no further protective packaging is necessary. The skin-tight coating is sufficient to seal in the insulating compound while the connectors are being removed from the jigs and placed in cardboard cartons for shipment to the field. When the connectors are ready to be used, the electrician can either peel back the plastic seal and insert wire or cable into the two ends of the connector or he can push the wire straight through the butyrate cap

# Protection for Engraving Plates

Engraving plates used to imprint cartons by Wilkata Folding Box Co., Kearny, N. J., are protected from damage or corrosion by butyrate coatings. One end of the plate is dipped into the tank by hand. After this coat has solidified, the plate is turned around and the opposite end is dipped. The tank holds 3 to 5 gal. of hot melt heated to a temperature of 350 degrees

In dipping larger size plates, the plate is held by string and single-dipped into the tank. Where size is unusually large, a ladle is filled with the hot molten butyrate and poured over the plate until it is completely sealed with the moisture-, corrosion-resistant coating. The coated plates are then hung over a metal-covered work table until they have dried. Excess plastic which drips off the plates will later be scraped off the table top and fed back into the melt tank for re-use

As compared to paper-wrapped plates (foreground), coated plates have many advantages: 1) they are less susceptible to damage; 2) entire job requires only one hour's time each week; 3) because coating is transparent, no labeling is necessary; and 4) the strippable plastic can easily be removed and re-used

As added protection for ophthalmoscope head included in medical kit, a special pocket is molded separately and inserted into polyethylene case. Molded-in recesses and ribs protect other precision parts and accessories

# Molded Cases for Precision Packaging

## Economies inherent in one-piece construction with integral hinge promote use of molded polyethylene cases for precision equipment

IN ONE of the most complicated phases of modern packaging, that of housing fine precision tools and instruments, molded polyethylene is beginning to make an important name for itself and may be well on the way to developing similar new markets in the over-all rigid packaging field.

Of particular interest to the packaging industry has been the demonstrated adaptability of polyethylene to intricate product design. Two recently introduced packages in the precision equipment field — one a molded case for diagnostic instruments, the other a molded case for a precision tap and die set — illustrate the functional use to which the outstanding molding qualities of polyethylene can be put.

Both of the packages are smart-looking, compact cases and both are designed to incorporate molded-in contoured cavities, supporting ribs, and other similar recesses required to house and safely protect the many small precision parts and accessories that make up kits of this type.

Also common to the two cases is an unusual one-piece construction with integral hinge that has already attracted considerable attention in the packaging industry. According to the manufacturers of both the medical kit and the tap and die set, the economies inherent in this basic one-piece design have meant a considerable reduction in production costs. Using the one-piece construction for the medical kit, for example, eliminated the need for expensive metal hardware and hinges and made it possible to market the polyethylene case for $4 less than the rubber-lined fabricated case it was designed to supplement.

The hinge is actually nothing more than a flat strip of polyethylene which is a continuation of the two halves of the case. As reported by the molders of the medical kit, the only major problem in molding the hinge area is the maintenance of the proper temperatures to prevent surface delamination of the hinge. A properly molded case will withstand hundreds of thousands of openings and closings before any sign of hinge failure is evident.

### Medical Kit

Prior to the adoption of the molded polyethylene case for the medical kit, Welch Allyn, Inc., Skaneateles Falls, N. Y., manufacturers of quality ophthalmic instruments, used first a wood, then a plush-lined leather case. Several defects were inherent in the conventional leather case, however, especially from the standpoint of wear. After a few months of use, the plush lining would become soiled while the leather exterior would scuff and become battered looking.

In contrast, the molded polyethylene case has much to offer. The excellent resiliency of the material not only cushions the delicate medical instruments from harm but provides a durable exterior that can withstand years of wear. In addition, the case can be washed or sterilized with standard germicides. Overlapping snap fasteners at the front of the case doubly insure dust free storage for the instruments.

The molded polyethylene case is also lighter in weight and more compactly designed than the conventional wood or leather cases — an advantage of extreme importance to medical men who normally have to carry a great deal of equipment.

The entire case measures only 8½ in. long and is less than 2 in. deep. It is molded of brown poly-

Thin strip of polyethylene joining the two halves of the one-piece case serves as an integral hinge. The special pocket section is also self-hinged (left)

Instruments nest compactly in compartments when the smartly tailored case is snapped shut. Overlapping snap fasteners insure dust-free storage (right)

ethylene — bottom half, top half, and hinge all in one piece — in a 2-cavity mold in a 22-oz. Impco injection molding machine with a special 12-oz. cylinder.

Taking advantage of the molding qualities of polyethylene, each half of the case is molded as a single unit that incorporates ribs, cavities, and recesses designed to hold each piece of equipment securely in place. In the bottom half of the case, for example, are a number of molded-in thin ribs which support the various nylon tips in the kit. Also in the bottom half of the case is a molded-in slot into which the end section of a pocket for the ophthalmoscope head fits. This pocket is molded separately of polyethylene at the same time as the case — and is designed so that one end of the pocket strip has wall sections sufficiently thick to protect the otoscope head, while the other end is sufficiently flexible to permit the pocket strip to be flipped up when the head is to be removed for use.

In the top half of the case are two molded-in seats which support the heavy otoscope handle.

To add to the appearance of the smartly tailored case, a simulated alligator hide design is molded into the exterior of the case. The case is tapered at the ends so that it can be easily slipped in and out of the physician's pocket.

### Tap and Die Set

The molded polyethylene case for the tap and die set offers much the same advantages of economy, dura-

(*To page* 231)

By designing resilient polyethylene box with molded-in contoured cavities, excellent protection is pro-

bines with economies in-

Use of platform to increase the number of parts that can be boxed combines with economies inherent in one-piece, self-hinged design to lower price of the end-product

## Colored Heat-Resistant Ash Trays

Designed for appearance, usefulness, and durability, heat-resistant ash trays molded of a polyester fibrous glass compound can be nested for storage. The ash trays are molded with a gently sloping edge, a flat bottom, and with four curved depressions on the lip in which cigarettes can be rested. Presently available in four pastel colors, the strong, lightweight trays have unlimited color possibilities because of the natural light color of the molding material.

The ash trays are compression molded on a 15-ton hydraulic press mounting a two-cavity beryllium-copper mold. The molding material is mixed to putty consistency and is then extruded into rope form. The length of the cut-off pieces is determined by the amount of material required for each mold. The cure time is approximately 10 seconds.

CREDITS: Manufactured by The X-M Co., 5631 Alexis Rd., Sylvania, Ohio. Polyester resin supplied by Barrett Div., Allied Chemical & Dye Corp., New York, N.Y.

## Floating Baby Blanket Fasteners

Blanket fasteners, called Floaties, keep babies' covers securely in place. Molded of cellulose acetate, the ring fasteners spread-split and snap easily onto the crib bars. Because they can float up and down on the bars, the fasteners allow the baby to kick as much as he likes without pushing the covers off, or over his face. A molded groove at one side of each ring holds a safety pin, which is large and strong enough to fasten as many as three blankets at once. Floaties are available in pink, blue, green, and yellow and are attractively packaged six in a molded transparent styrene snap-fit container.

The blanket holders are produced in a ten-cavity mold operating on an 8-oz. injection molding machine; molding cycle is approximately 30 seconds The safety pin is inserted into a slot in the side projection on the ring by means of an air-operated punch press. The upper part of the slot has a deep undercut which holds the pin firmly in place.

CREDITS: Molded and manufactured by Ric-Tur Plastics Co., Leominster, Mass. Cellulose acetate supplied by Eastman Chemical Products, Inc., Kingsport, Tenn.

# PRODUCTS

## Planter-Lamp With Built-In Water Supply

Combination planter-lamp called Cobbler's Bench is designed to blend with any room decor used in the home. Molded of stain-resistant styrene, the unit incorporates a water reserve located in a drawer directly below the plant well which simplifies watering of the plant. A baffle set into a hole in the well leads to the water supply below, allowing water to pass up to the plant. A standard lighting socket is held to the bench by a threaded retainer. The styrene shade is fastened directly to the bulb by means of a bulb clip attached to the shade. When lighted, a soft pleasant glow is emitted through the pastel tinted shade.

Parts for the Cobbler's Bench planter-lamp are produced on an injection molding machine using a six-cavity mold. The lamp includes six separate parts: a shade, baffle, drawer, bench, and two sets of legs.

CREDITS: Manufactured by Earl Fisher Plastics Co., 347 E. Barthman Ave., Columbus 7, Ohio. Styrene supplied by Monsanto Chemical Co., Springfield, Mass.

## Shaving Brush With Soap Reservoir

Called the Digit Automatic, a new shaving brush eliminates the necessity of applying shaving cream to the brush by hand each time it is used. Molded of nylon, the automatic brush carries its own supply of shaving cream in the handle. Cream is forced through a tube in the top of the handle into the bristles when the base is turned. The interior surface of the handle is threaded, as is also a disk or piston which advances or retracts within the handle when the base is turned. Base and piston are linked together by a spring. The brush can be refilled by unscrewing the brush collar and forcing cream into the handle cavity. It is claimed that a one-quarter turn of the base will provide enough shaving cream for one shave. The bristles can be easily cleaned by flushing with warm water.

The six molded parts of the automatic shaving brush are produced in a six-cavity mold on a 2-oz. injection molding machine.

CREDITS: Molded by Molding Specialists Inc., 289 Nepperhan Ave., Yonkers, N.Y. for Durobuilt, 360 Alexander Ave., New York 54, N.Y. Nylon supplied by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

# PLASTICS

## Detachable Sun Visor

Designed primarily for office use, an eye shade called Nu-Vue Visor also can be used at the beach or for other outdoor activities to protect the eyes from the glare of artificial or natural light. Molded of styrene copolymer, the lightweight and weather-resistant visor is attached at right angles directly to sun or reading glasses by means of elastic bands which, held in holes in the visor, pass over and around the bows on the glasses and are slipped into slots in the visor. The visor is designed so that its reflecting side is up and its dull-finished side is near the eyes.

The eye shade visors are produced in a four-cavity mold mounted on a 4-oz. injection molding machine. Molded-in holes provide for holding the elastic bands. Slots to anchor the free end of the elastic bands are machined in place after the molding operation.

CREDITS: Manufactured by Avsco, Inc., 940 Isley Blvd., Excelsior Springs, Mo. Styrene copolymer supplied by The Dow Chemical Co., Midland, Mich.

## Floating Bath Thermometer-Rattle

A combination baby bath thermometer and toy rattle, called Tubby-the-Turtle, is molded of styrene and will float in a tail-down position in baby's bath water, being held in this position by steel balls placed in the tail; these balls cause a rattling noise when Tubby is shaken. The water temperature is indicated by thermometer calibrations of hot, warm, tepid, temperate, or cool. Tubby is so designed that the thermometer bulb stays well under water to insure an accurate temperature reading. Tubby-the-Turtle is available in nursery colors of pink and blue combinations and has smooth contours so that it will not scratch baby's tender skin.

The combination thermometer and rattle is injection molded on a 4-oz. machine, using a two-cavity mold to form the two half sections. The steel balls are placed in one half of the toy and the other half is cemented in place to form the completed unit.

CREDITS: Molded by Ideal Plastics Corp., 184 Jamaica Ave., Hollis, N.Y. for Taylor Instrument Companies, 95 Ames St., Rochester, N.Y. Styrene supplied by The Dow Chemical Co., Midland, Mich. and Monsanto Chemical Co., Plastics Div., Springfield, Mass.

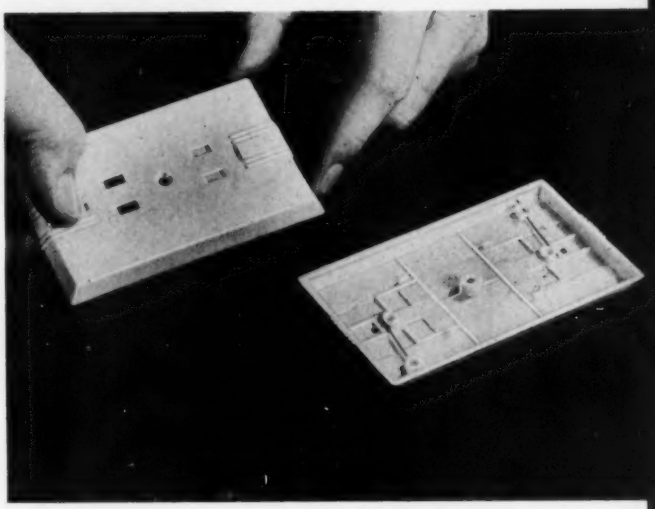
# PRODUCTS

## Outlet Plate With Safety Doors

Automatic safety device for electric outlets can be installed permanently and simply without additional wiring. The styrene outlet cover, called Shok-Pruf Safety Cover, can be fastened to any wall receptacle with the same screw that would hold the conventional plate in place. Each duplex safety cover is provided with two sliding doors that completely seal the outlets from probing fingers when electric appliance plugs are not covering them. When a plug is to be inserted, one safety door is moved out of the closed position by means of a spring loaded button at one end of the cover; when the electric plug is removed from the outlet, the safety door automatically snaps closed.

The cover parts are produced in a four-cavity mold on a 9-oz. injection molding machine. Tension springs are heat-sealed into position.

CREDITS: Manufactured by Cable Electric Products, Inc., 234 Daboll St., Providence 7, R. I. Styrene supplied by Monsanto Chemical Co., Springfield, Mass.

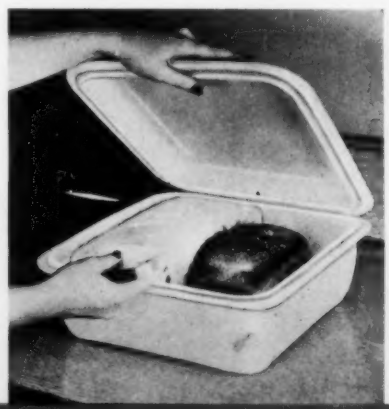


## Many-Purpose Food Container

New lightweight cake and bread keeper that can also be used as a dishpan, food crisper, or all-around kitchen storage unit is molded of flexible polyethylene. This multi-purpose food container has an extra deep cover which is designed to make a vapor-tight seal with the shallow base to prevent food from drying out. A tapered finger slot at the seal facilitates separating the halves. The unit can be turned over and the deep cover converted to a bread box big enough to hold two large-size loaves. A detachable wire handle that snaps on firmly over the flanges of the seal makes the food holder ideal for picnic use. In an emergency, the deep cover also serves as a dishpan. Polyethylene resists staining by most food chemicals, as well as water, soaps, and detergents. The food container is available in colors and two models: with or without detachable carrying handles.

The unit is produced on a 24-oz. injection machine in two single-cavity molds. Duration of the molding cycle is approximately 70 seconds.

CREDITS: Molded by Plastray Corp., Fisher Bldg., Detroit 2, Mich. Polyethylene supplied by Bakelite Co., New York, N.Y.



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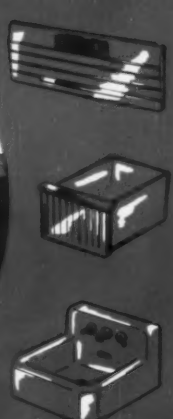

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# Runnerless Injection Molding

How injection molding profits can be increased by the application of proved principles which speed production and eliminate scrap

by ERNEST P. MOSLO‡

FROM a production standpoint, runnerless injection molding can mean additional profits to the molder, or the difference between profit and loss on many jobs, particularly when quantities run into high figures. While the first cost for molds for runnerless molding is, in many cases, considerably higher than for conventional runner or tunnel-gated molds, this additional cost can be more than offset by increased production rates that are obtainable and by the saving of runner scrap.

The following description of a number of hot nozzle molds is based on a hypothetical container mold, and the nozzles are so illustrated in the drawings. However, the drawings do not purport to illustrate specific and practical mold design. They are presented only for the purpose of detailing nozzle and gating construction in general. In addition, the illustrations are not precisely to scale, but all of the experiments described have been thoroughly tried. Many of the ideas put forth are in actual production use today in high-speed automatic injection molding operations.

Runnerless molding can involve several different methods. The following, all tried and proved, will be detailed in this article: 1) direct injection from a nozzle into a single-cavity mold; 2) direct injection from multiple nozzles into two or more cavities; 3) hot or confined runners to multiple cavities; 4) production of phonograph records with runnerless molds.

## Direct Injection

The writer has done a considerable amount of experimental work on direct injection from a nozzle into a single-cavity mold. In one of the first trials an extension nozzle was used of the type shown in Fig. 1. The nozzle was 1 in. in diameter and the end of the nozzle formed the bottom of the cavity. Molding with this set-up was fairly successful but, because the hot nozzle was in contact with a large area of the molded part, a large nozzle impression was left on the molded piece and production speed was limited. The internal construction of the nozzle was good and very little trouble with freezing was experienced in production. It was apparent, however, that the area of contact between the outside diameter of the nozzle and the mold must be kept to a minimum. It is also important that the nozzle extension be heated and that accurate temperature control be maintained at all times.

Should the nozzle freeze while the machine is down, operation can be started up again by one of two methods: 1) increase the temperature of the nozzle by 20 to 30° F.; 2) back the nozzle out of the mold opening completely and let it heat for 30 to 60 seconds.

In the course of development work, nozzles with increasingly smaller diameters, but of this same general construction, were tried. Finally, as shown in Fig. 2, nozzle size

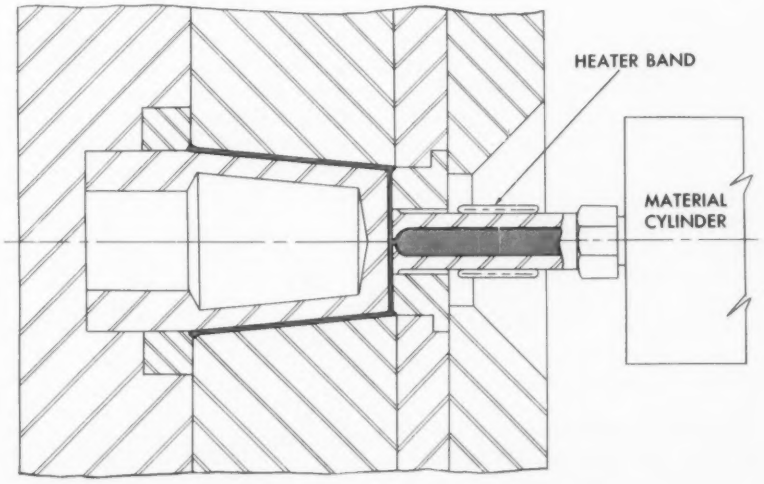


Fig. 1—Extension nozzle used in early work on direct injection

* Reg. U. S. Pat. Off.
† Adapted from a paper presented at the 11th Annual Technical Conference of The Society of Plastics Engineers, Inc.
‡ President, Moslo Machinery Co., Cleveland, Ohio; Vice President, The Society of Plastics Engineers, Inc.

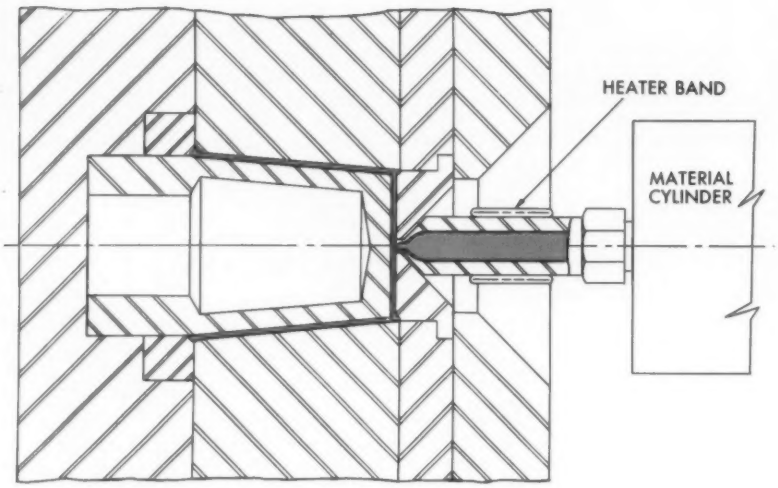


Fig. 2—Reduction in nozzle size (compare with Fig. 1) increased production speed

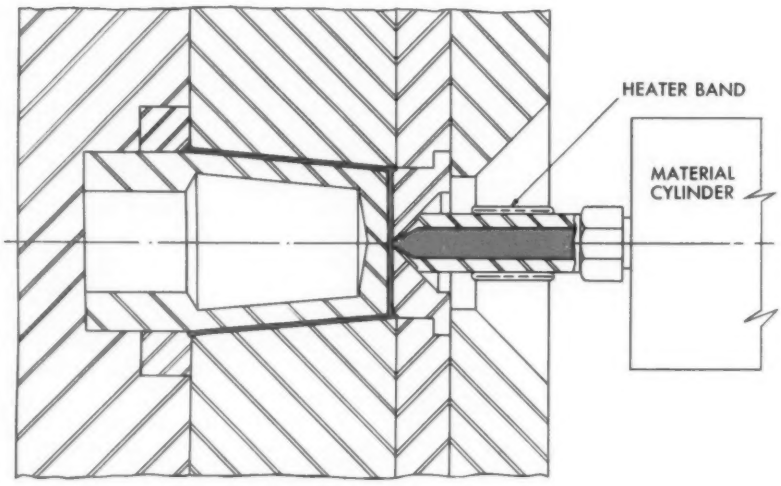


Fig. 3—Tapered nozzle, best so far developed, leaves minimum mark on molded parts

was reduced to an outside diameter of ¼ inch. With this much smaller nozzle diameter, the danger of freezing is increased and it is important to keep the amount of metal-to-metal contact between the mold and the nozzle at a minimum. The nozzle illustrated worked very well and production increased over that obtained when using the nozzle shown in Fig. 1. This increase was largely due to the smaller contact area between the nozzle and the bottom of the molded part. Also, the impression left by the smaller nozzle is not as unsightly as with the 1-in. nozzle.

This type of construction is desirable for molding containers such as a compact or a box, where the gate is on the bottom, or other parts that are used in assemblies where the gate mark is covered. It is also an excellent approach to automatic runnerless molding with a nozzle or nozzles in direct contact with one or more molded parts.

Continued development work resulted in the nozzle design shown in Fig. 3. This nozzle has a 90° taper on its outside diameter, tapering to a diameter of $\frac{3}{32}$ in., which diameter protrudes into the bottom of the mold cavity. The nozzle shown in Fig. 3 is the best so far developed, and its internal construction is very important. The inside of the nozzle is a straight bore ½-in. in diameter, reduced on a 60° included angle to an opening 0.030 to 0.040 in. in diameter. This is the gate into the cavity and the precise size of the opening will depend on the part to be produced. This nozzle left a minimum of surface blemish on the finished part. It was also found that if a land should be left at the opening of this nozzle, rather than bringing the 60° taper completely to the gate, freezing will occur.

Another problem with the type of nozzle shown in Fig. 3, is that the contact area between the nozzle and the mold must be kept to a minimum; to this end, it is practical to relieve part of the contact area. In many cases, a beryllium copper nozzle tip will be found more satisfactory than tool steel. And, again, temperature control is of utmost importance for production runs.

## Molding Thin Disks

A molding problem recently encountered was that of producing disks of the type shown at the right in Fig. 4. The single-cavity mold for this part had been in existence for several years but it had been found impossible to run the part in production. Attempts had been made with machines as large as 8 oz. without satisfactory results. After this mold was rebuilt into a standard 8- by 9-in. mold base, it was installed in a standard ½-oz. high-speed fully automatic injection molding machine having a maximum injection pressure of 16,000 p.s.i. and equipped with a nozzle of the same construction as shown in Fig. 3. With this

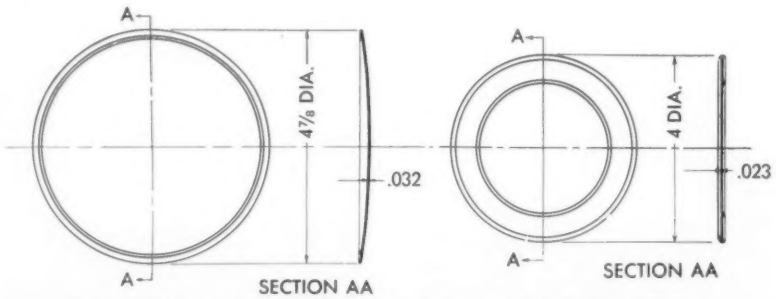


Fig. 4—Disks presented molding problems that were solved by direct injection

set-up, it was found entirely possible to produce satisfactory finished parts at a production rate of 720 pieces per hour. The part was molded in both high-impact and in free-flow styrene.

Another similar molding problem was concerned with the production of a slightly curved disk of the size and shape shown to the left in Fig. 4. The material to be used was a special high-heat styrene copolymer that is ordinarily much more difficult to mold than standard styrene. However, with the nozzle shown in Fig. 3, it was possible to mold these disks of this tough material at a production rate of over 600 pieces per hour, fully automatically. Originally, this curved disk was molded with an edge gate from a runner, and the parts were highly strained. Center gating from a hot nozzle offered very definite advantages, and it is the writer's belief that in this and other cases nozzle construction is of utmost importance to successful operation. Again, it was found that a beryllium copper nozzle tip resulted in better operation; heat transfer to the material was much better and freezing at the nozzle was eliminated.

## Eliminating Nozzle Mark

In an effort to completely eliminate nozzle marks on molded parts, a mold was constructed with a bottom of the type shown in Fig. 5. An ordinary ball-point nozzle was used with a reverse taper extending a short distance back into the larger mass of hot plastic material. As in all other cases detailed here, the nozzle itself was heated. In the drawing, the distance from the end of the nozzle to the bottom of the molded part, as well as the gate diameter, are exaggerated to clarify the design. Actually, the distance from the end of the nozzle to the bottom of the cavity must be as short as possible. Also, the reverse taper should extend from the nozzle into the cavity. Here again, beryllium copper for the nozzle or for the nozzle tip will be found to have advantages over steel nozzles.

Water cooling of the mold near the nozzle is of utmost importance to keep production high and to produce a part with a good finish at the gate. The temperature of the mold core and cavity, as well as of the nozzle, must be controlled very precisely. If all these elements are given proper attention, very smooth gate breakoff can be maintained, and what little mark is left can be blended into the design of the finished part.

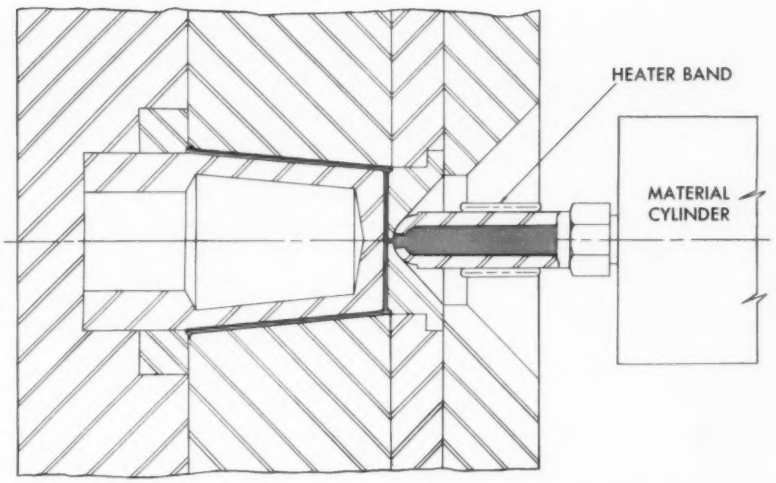


Fig. 5—Gate diameter and length are exaggerated for clarity. See text at left, below

## Stringers

An important point that has come up in connection with this development work on runnerless molding and nozzle design concerns the formation of stringers as the part leaves the mold. These stringers occur only when temperature is not properly controlled and where excessive heat is applied to the material in the plasticizing chamber. With adequate plasticizing capacity, with good nozzle design, and with good temperature control throughout, stringers can be completely eliminated.

With this approach to the stringer problem, parts will be more promptly removed from the mold and the injection machine will not miss cycles because of stringers. Furthermore, it shows a way of doing away with methods of removing stringers or of cutting them off at the nozzle. Such measures require cumbersome moving parts and slow down operations.

## Direct Injection, Multiple Cavities

In an article describing a new concept of hot-runner molding published in MODERN PLASTICS, Sept. 1954, p. 123, the subject was intro-

(*To page* 124)

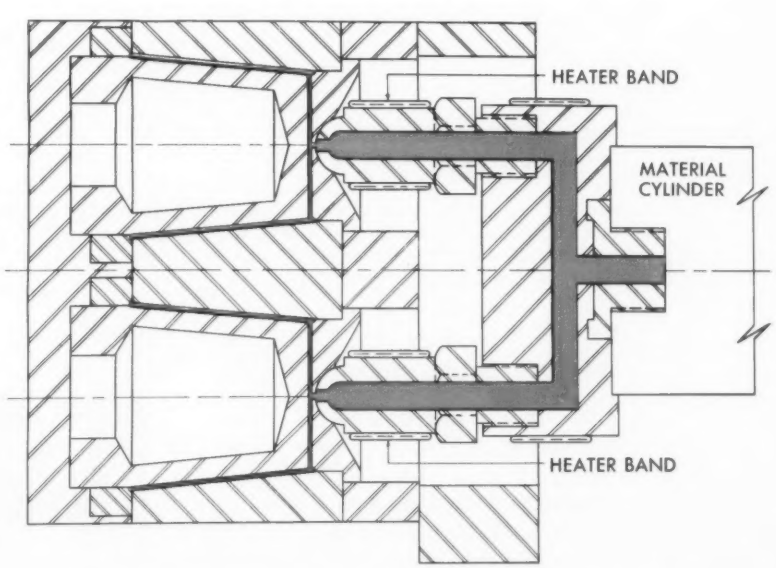


Fig. 6—Multiple nozzle injection, with manifold attached direct to cylinder

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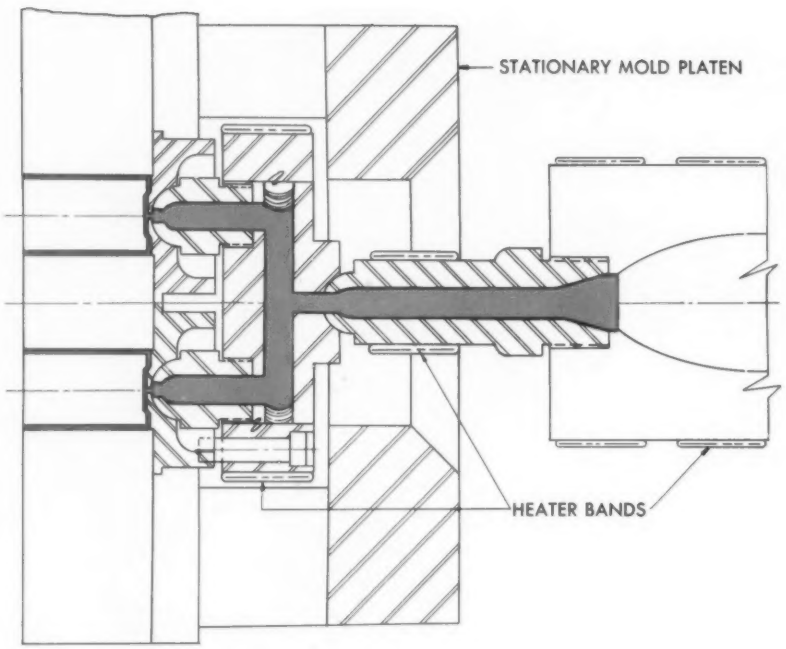


Fig. 7—Multiple nozzle injection, with floating manifold

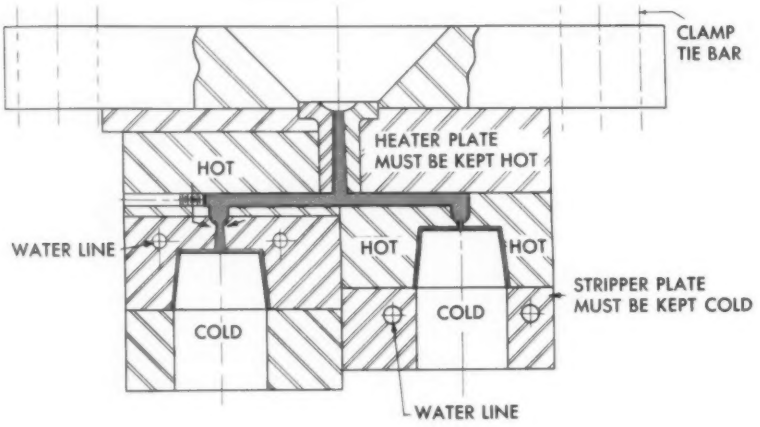


Fig. 8—Two methods of using hot runner molds

duced as follows: "There are almost as many different approaches to mold design for fully automatic injection molding as there are different breeds of dogs, and there are just as many differences of opinion as to which is the best way to do the job." This statement applies to automatic and runnerless molding.

Several methods of multiple nozzle injection have been tried successfully. One approach is shown in Fig. 6, where a manifold is attached directly to the heating cylinder. One of the advantages of this type of construction is a very rigid assembly. Efficient heating can be provided for the manifold and for the individual nozzles, which may be any one of the previously described designs. Passages for flow of the heating plastics material from the heating cylinder to the cavities are very short and temperature control can be highly accurate. Heat transfer from the manifold to the mold is very slight.

One of the main disadvantages of the design shown in Fig. 6 is that a special platen is necessary. These platens can be provided with a predetermined number of nozzle openings in a given pattern but mold design then becomes limited to it.

Still another approach to multiple-nozzle injection is shown in Fig. 7, which is an actual layout for use with a high-speed fully automatic molding machine. The heating cylinder and nozzle arrangement are standard. The manifold, however, is a floating member and the only contact between it and the mold is through the tips of the multiple nozzles. The manifold is loosely held against the mold while the mold is installed; manifold and mold are then centered directly on the main nozzle of the machine. After installation, pressure on stripper bolts can be released so that the entire unit becomes a floating member. This appears to be an excellent design for multiple nozzle molding.

Although the mold shown in Fig. 7 is a four-nozzle arrangement, any practical number of nozzles may be used. The manifold need not be round; it can be rectangular, square, or of any desired shape. The main factors are adequate heat and precise temperature control.

Hot or confined runners feeding into multiple-mold cavities have been frequently used, but this system is another that can still stand a lot of improvement.

Two methods of using hot runner molds are illustrated in Fig. 8. The following description of the method shown on the right hand side of the cross-section is quoted from an article which appeared in MODERN PLASTICS, June 1952, p. 101:

"In a hot runner mold, the gate

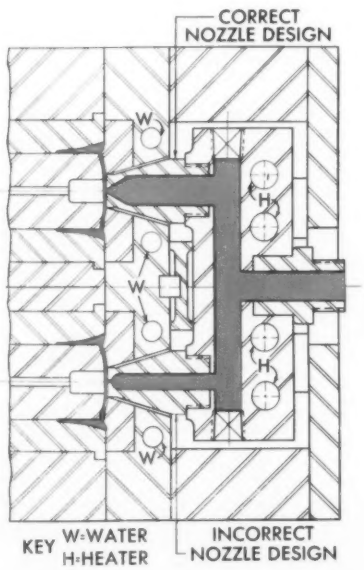


Fig. 9—Nozzle designs discussed on p. 126

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half of the mold is composed of two separate plates known as the heater plate and the runner plate. These two components are bolted together. The heater plate is equipped with electrical heating elements located in such a manner that the over-all temperature of the plates is as uniform as possible. Thermostatic control maintains both the runner plate and the heater plate at a temperature which is sufficient to keep the thermoplastic material in the runners in as plastic a state as when it leaves the injection nozzle. . . .

"One of the first problems that had to be overcome had to do with strengthening the assembly of the heater plate and the runner plate. Four bolts were used for this purpose in the first mold. When the first shot was taken, these four bolts snapped, and the hot plate and runner plate fell apart. This indicated the terrific pressure which was exerted because of the projected area of the runner.

"Because of the high rate of heat transfer between the hot cavity side of the mold and the cold force plug side of the mold, it was found that a circulating medium colder than tap water was required on the force plug side in order to cool the polyethylene quickly enough to obtain a fast molding cycle. Eventually a complete refrigeration and circulating system was built, in which an ethylene-glycol solution is maintained below 30° F. With this low-temperature cooling medium on the force plug side of the mold, cycles better than four shots per min. are maintained."

Another type of hot-runner mold is shown in the left hand section of Fig. 8. Both of the designs presented in this drawing have limitations. It is very difficult to keep the hot side of the mold hot enough and the cold side of the mold cold enough for fast cycles. Heat is wasted by excessive cooling on one side and excessive heating on the other. Heat transfer to machine platen is also a problem.

The hot-nozzle arrangements that have been described for single- and multiple-cavity operation are, in the writer's opinion, superior to the hot-runner mold design shown in Fig. 8. The hot nozzles are more economical to operate both from a heat input and an increased production standpoint. Also, isolation of heat from the mold and from the machine is simplified. Temperature can be very accurately controlled and there is no bucking of heating and cooling.

Correct and incorrect nozzle designs for a hot-runner set-up are shown in Fig. 9, based on a 6-cavity mold for producing caps for an aerosol can. The incorrect nozzle design was too small in diameter and had too much land. The nozzles would freeze constantly during operation. In the correct nozzle design, the diameter of the hole through the nozzle was increased from ¼ in. to ½ in. and a 60° included angle was machined directly through the end of the nozzle to an orifice approximately 0.040 in. in diameter. When these changes were made, the mold operated satisfactorily. The hot-runner plate is isolated from the back of the mold and from the cavity plate. Cooling water passed directly through the mold on either side of the nozzles. Thus an incorrect hot-runner mold design can be changed to one that will give satisfactory production operation.

Figure 10 illustrates a different

(To page 232)

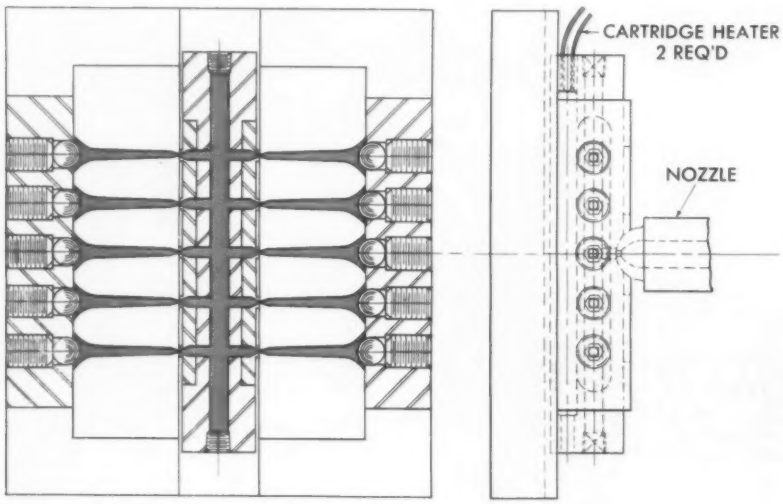



Fig. 10—Hot runner molding set-up with square runner bar on stationary mold half

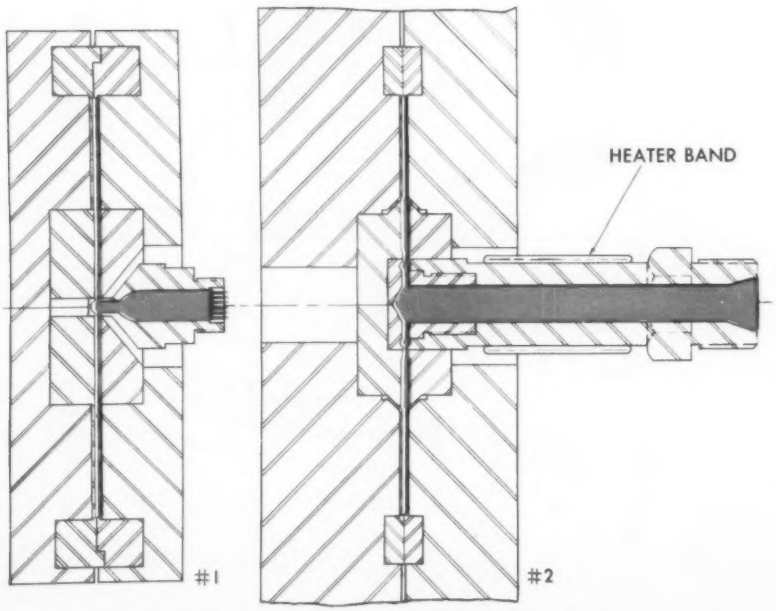



Fig. 11—Two phonograph record molds for direct injection. See description on p. 234

## Temperature and Pressure Measurements in

# The Injection Machine Heating Cylinder

by C. E. BEYER,* R. B. DAHL,* and R. B. McKEE*

**The accompanying article is the first of a series of three papers dealing with fundamentals affecting the injection molding machine so far as the heating cylinder is concerned. These three papers were presented at the 11th Annual Technical Conference of the Society of Plastics Engineers, Inc. The other papers will be published in the Plastics Engineering department of *Modern Plastics* in successive months. Part 2 will treat with temperature variations in the heating cylinder and Part 3 will consider the effect of design factors on heating cylinder performance.**

THE FUNCTION of the heating cylinder in an injection molding machine is to soften the plastic material so that it can be formed into the shape of the mold. The temperature and pressure behind the plastic as it leaves the nozzle are two very important variables in the molding cycle. The purpose of the work reported here on the injection molding machine heating cylinder is two-fold:

1) To develop tests that will accurately measure the plastic temperature and pressure at the nozzle of the heating cylinder.

2) To use these tests and other auxiliary tests to study various designs of heating cylinders and hence determine how changes in design will affect the performance of the heating cylinder.

### Temperature Measurements

Early in the development of the injection molding machine, it was discovered that because of the low thermal conductivity of plastics the heating surface had to be greatly increased and the thickness of the plastic layer had to be decreased. The principal method of doing this was to introduce a spreader or torpedo into the heating cylinder. A typical heating cylinder, without construction details, is shown in Fig. 1.

The plastic enters Zone A in the form of hard, cold, granules. These granules are compacted and heated, and the material eventually leaves the nozzle as a viscous fluid. All conditions between these two extremes exist in the heating cylinder.

Since the major absorption of heat by the plastic takes place between the spreader and the heater body, the heating cylinder can be further simplified. For the calculation of the theoretical heating efficiency of a heating cylinder, the plastic can be considered to be in the shape of a tube, as in Fig. 2. Because of the simple geometric shape of the plastic in this region, the equations of heat transfer for an infinite slab can be applied, neglecting end effects. It should be remembered that although most of the heating cylinder has this shape, the spreader must be supported in the cylinder. As a result the equations will not be 100% accurate and the calculations are made only to indicate the possible range of performance.

The plastic will leave the nozzle with an average temperature ($T_a$) which is usually much lower than the temperature of the cylinder walls. The temperature of the plastic leaving the nozzle of a given

* Plastics Basic Research Laboratory, The Dow Chemical Co., Midland, Mich.

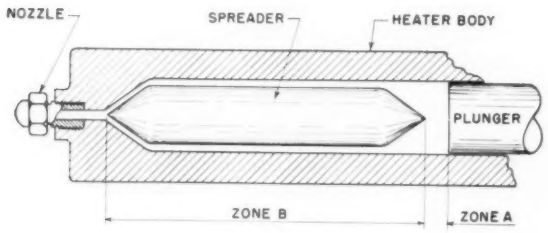
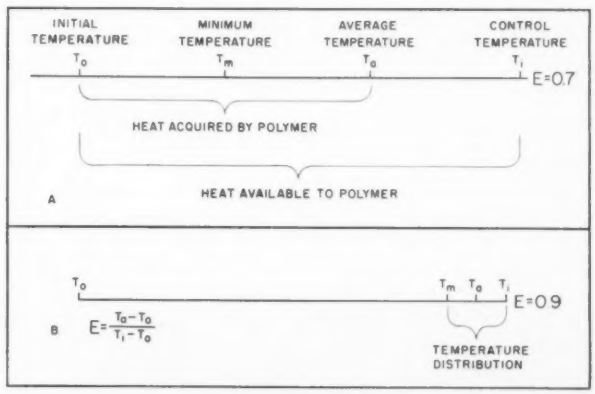


Fig. 1, left—Typical injection machine heating cylinder

Fig. 2, lower left—Material can be considered as a tube

Fig. 3, below—Temperature ratios as discussed on p. 128



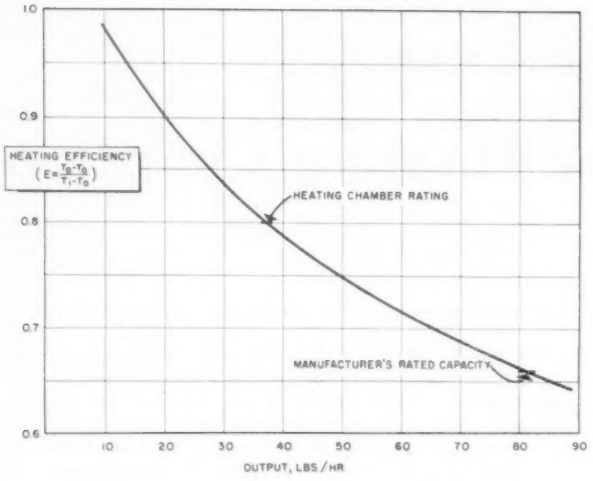



Fig. 4—Efficiency curve for comparing heating cylinder performance

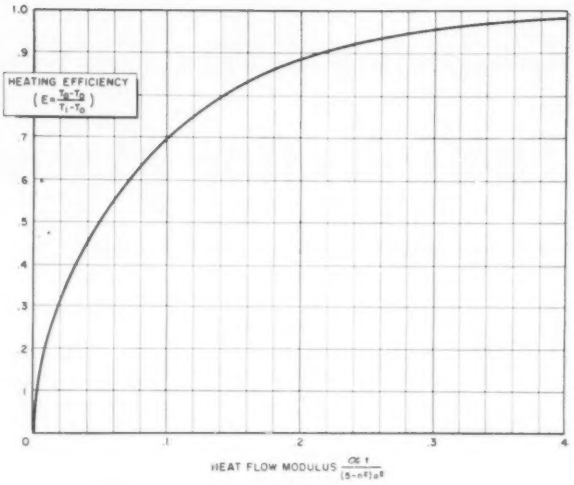



Fig. 5—Graph for heat transfer equation. See text p. 130

cylinder will depend upon: 1) the temperature of the cylinder walls or heater temperature; and 2) the contact time or production rate. In the injection molding machine the plastic is pushed into the heating cylinder at some initial temperature ($T_o$). This is either the temperature of the room or the temperature of the hopper.

As the plastic moves through the heating cylinder, the temperature rises. This temperature increase can be expressed as ($T_a - T_o$) and, since it is directly proportional to the amount of heat absorbed by the plastic, it is a measure of the output of the heating cylinder. If the plastic remained in the heating cylinder long enough, it would eventually come very close to the temperature ($T_i$) of the cylinder walls. Thus the maximum possible temperature rise can be expressed as ($T_i - T_o$) and would be proportional to the maximum amount of heat the plastic could possibly acquire. The ratio of the actual amount of heat absorbed to the theoretical or maximum amount has been called the heating efficiency and expressed as

$$E = \frac{T_a - T}{T_i - T_o}$$

In Figs. 3A and 3B, ($T_i - T_o$) is proportional to the maximum amount of heat that could be acquired by the plastic, and ($T_a - T_o$) is proportional to the actual amount of heat acquired by the plastic as it passes through the heating cylinder. The ratio of these can be defined as an efficiency of heating the polymer. As shown in this illustration, there is also some minimum temperature ($T_m$) of the plastic as it leaves the nozzle, and the temperature distribution spread will be ($T_i - T_m$). Figures 3A and 3B show that the smaller the temperature variations in the plastic, the higher will be the value of the heating efficiency. So $E$ is not only a measure of the average temperature of the polymer as it leaves the nozzle, but is also an indication of the temperature distribution. It should be noted that since this heating efficiency contains the ratio of plastic temperature rise to maximum temperature rise, it is independent of the control temperature. Thus, any efficiency rating of the heating cylinder does not require a qualifying control temperature but may be used at any temperature (1)[1].

The heating efficiency can be measured at several different throughput rates and a graph of heating efficiency versus output rate can be drawn. This heating efficiency curve can be a very effective means of comparing the performance of heating cylinders. A typical curve is shown in Fig. 4. Since the heating efficiency is independent of the heater temperature, the average plastic temperature can be found for a large range of heater temperatures and production rates.

It might be useful to a molder to have a curve like this for each of his machines. This would give him an accurate comparison of the various machines. A simpler way of using these curves, although less complete, is to choose a standard value of $E$ and compare the output rates of various machines at this value. Since the maximum production rate of a molding machine is ambiguous and will depend on the heater temperature, the material, and the complexity of the mold, it is almost impossible to choose a maximum output that will have any meaning. Rather than this we have chosen a standard rated efficiency of 0.80. At this value the plastic will be fairly uniformly heated and will be in the range of output rates used for high quality moldings with a minimum of strains. The approximate variations in plastic temperature at various heater settings are given in Table I, p. 136.

Another reason for choosing this $E$ value is the accuracy of the experimental measurements. At very low values of heating efficiency the temperature distribution is so great that the accuracy is low, but at high heating efficiencies the accuracy is much better.

Although this method has proved satisfactory in rating the plasticizing efficiency of a heating cylinder, it will not tell much about the design. The plasticizing rate of a given heating cylinder will depend upon two things: 1) the size of the cylinder; and 2) the basic design of the cylinder. To evaluate the effectiveness of the design to supply heat to the plastic, it becomes necessary to divide out the effect of the dimensions on the plasticizing rate. To do this, it is necessary to go back to the equations of heat conduction and separate these two variables.

The theory of heat transfer

[1] Numbers in parenthesis link to references at end of article, p. 256.

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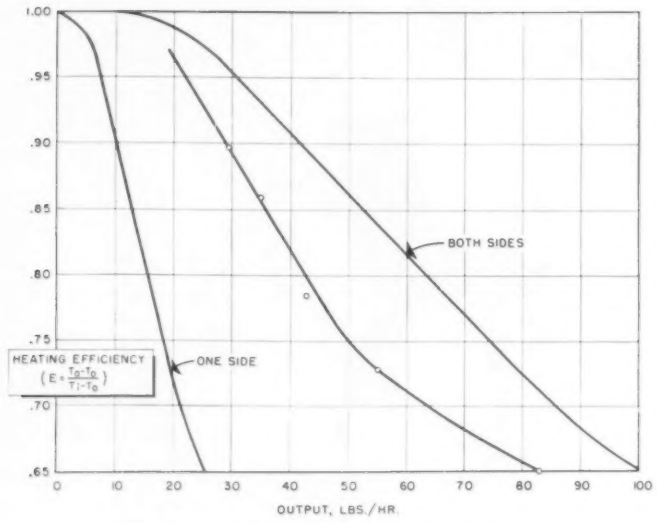



**Fig. 6—Heating efficiencies at various output rates**

through a flat slab has been well established (2). The quantity of heat taken up by a slab of plastic depends upon: 1) the thermal diffusivity of the polymer; 2) the contact time or inventory time in the cylinder; 3) thickness of slab.

1) The thermal diffusivity is a product of the three thermal properties of the polymer: the thermal conductivity (K); specific heat (C); and density (P) and equals

$$\alpha = \frac{KP}{C} \qquad \text{Eq. 1}$$

This value is reasonably constant over the temperature range used and will not vary as long as one type of polymer is used.

2) The average contact time can be expressed in terms of the dimensions of the heating cylinder and other terms commonly used in injection molding. The contact time is equal to the inventory weight ($V_p$) divided by the shot weight (W) and multiplied by the total cycle ($t_c$). This may be written as

$$t = \frac{V_p t_c}{W} \qquad \text{Eq. 2}$$

The output of plastic through the heating cylinder (Q) may be introduced since it is equal to shot weight divided by total cycle.

$$Q = \frac{225\ W}{t_c} \qquad \text{Eq. 3}$$

Substituting this in eq. 2 results in

$$t = \frac{225\ V_p}{Q} \qquad \text{Eq. 4}$$

From the heat transfer equation, the ratio of actual temperature rise to the wall temperature can be given in terms of the thermal diffusivity, contact time, and slab thickness. Since this equation is rather complicated, it is given in graph form in Fig. 5. From this graph the value of

$$\frac{\alpha\ t}{a^2}$$

can be found for any value of *E*. This equation can be expressed functionally as

$$E = f\left(\frac{\alpha\ t}{a^2}\right) \qquad \text{Eq. 5}$$

and will apply to an infinite slab heated from both sides. If the torpedo were cold, the result would be a slab heated from only one side, which would effectively double the thickness of the slab. In this situation the denominator is changed and the equation becomes

$$E = f\left(\frac{\alpha\ t}{(2a)^2}\right) \qquad \text{Eq. 6}$$

In the injection molding heating cylinder, heat is usually supplied through the heater body to one side of the slab. However, heat is conducted into the spreader through the connections with the heater barrel. The amount of heat going into the spreader will depend primarily on the amount of contact surface between the spreader and the heater barrel. In general, unless an internal heater is used, the spreader temperature will be less than the barrel temperature and the amount of heat supplied to the plastic will be somewhere between that given by eq. 5 and 6, and the number of sides heating the slab will be something less than two. If a coefficient (n) is introduced, which is equal to the number of effective sides heating the plastic, eq. 5 and 6 can be written (3) as

$$E = f\left(\frac{\alpha\ t}{(5-n^2)\ a^2}\right) 1 \leq n \leq 2 \qquad \text{Eq. 7}$$

When the heating efficiencies are measured at various output rates, a curve can be drawn similar to that in Fig. 6. By comparing this curve with the two theoretical curves calculated from eq. 5 and 6, the value of n can be found. This value n is a measure of the amount of heat supplied to the plastic from the spreader.

Using eq. 7 and choosing a particular value for the heating efficiency, for example E = 0.8, then it is possible to set

$$\frac{\alpha\ t}{(5-n^2)\ a^2} = K_R \qquad \text{Eq. 8}$$

where $K_R$ is a constant that is de-

(*To page* 135)

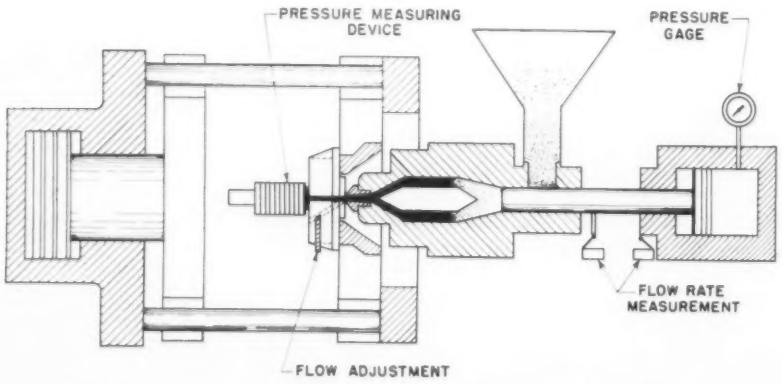
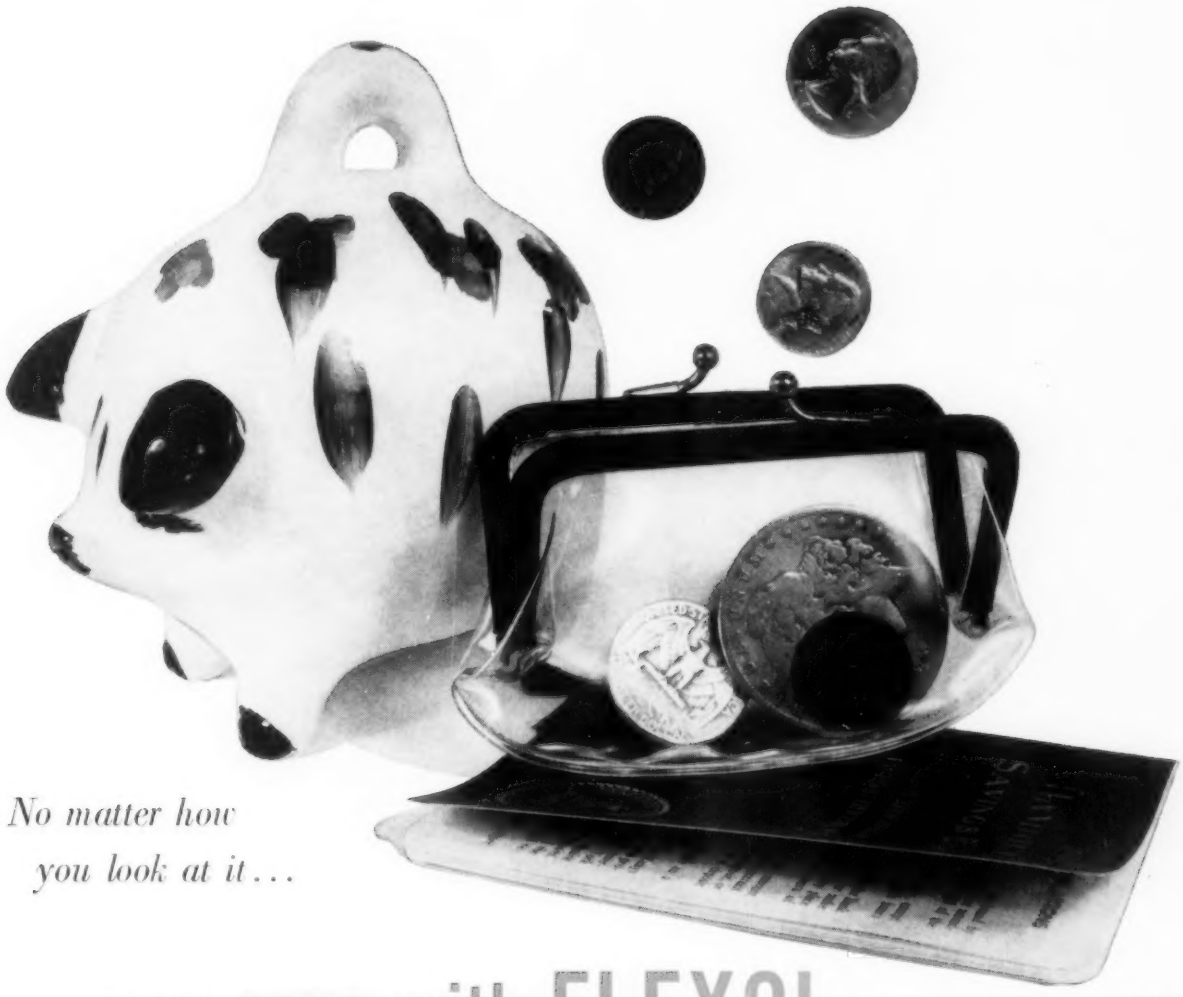



**Fig. 7—Apparatus for measuring pressure and temperature in heating cylinder**



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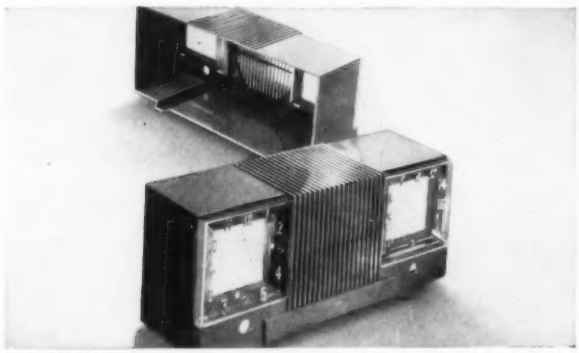
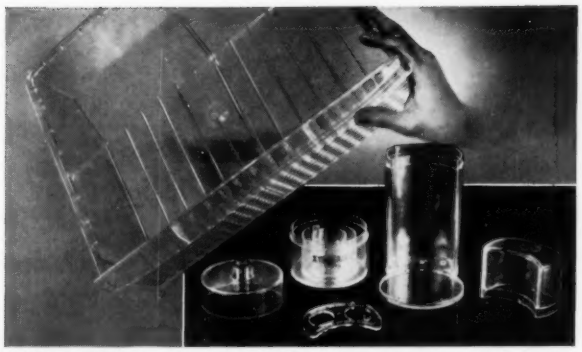
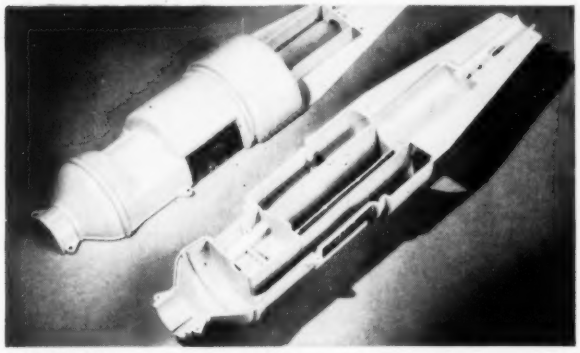


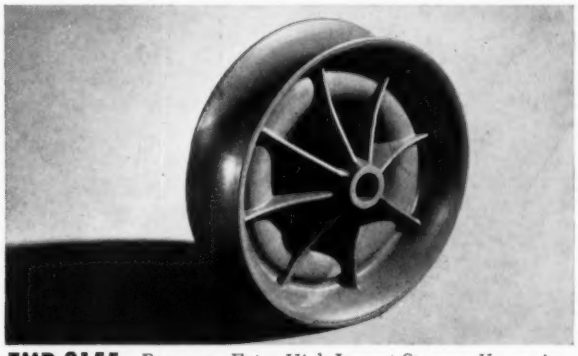
**SMD-3000**—the BAKELITE Styrene Plastic with a high heat distortion point of 197 deg. F. measured on an unannealed test bar ¼ in. thick. Offers reduction in molding pressures, better mold release, faster cycles. Has same color and clarity as other BAKELITE Styrene molding materials. Warping and distortion were completely eliminated in molding these radio cabinets from SMD-3000. They showed no stress-crazing even after immersion in n-heptane. Notice fine details, glossy surfaces in these front and rear views.



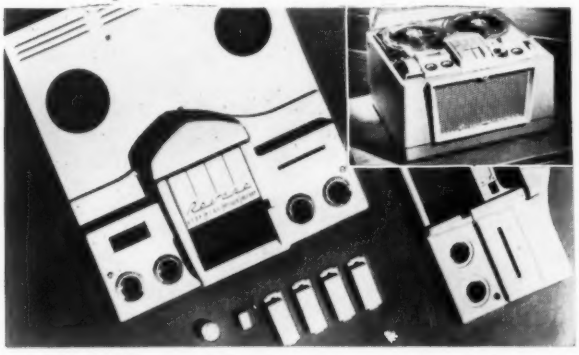
**SMD-3500**—BAKELITE General-Purpose Styrene. Noted for its combination of high plasticity and fast set-up. One manufacturer reported a 50 per cent decrease in molding cycle time plus complete elimination of sink marks. Another manufacturer was able to reduce cylinder temperature by 50 deg. F. while gaining a faster molding cycle. SMD-3500 flows more easily at conventional molding temperatures. It is equally serviceable for the big crisper drawer and the close-fitting syringe holder parts shown here.



**TMD-5151**—BAKELITE High-Impact Styrene. Has over eight times the impact strength of general-purpose styrenes. (ASTM average Izod test values using notched ¼ in. bar at 74 deg. F.). Inherently high plasticity results in fastest set-up speed available with a high-impact styrene. Surface gloss is outstanding. Opaque color range is unlimited. Colors can be duplicated from blend to blend. Construction of these toy vacuum cleaner parts shows intricate details possible with TMD-5151.



**TMD-2155**—BAKELITE Extra-High Impact Styrene. Has an impact strength about eighteen times that of general-purpose styrenes. (ASTM average Izod test values using notched ¼ in. bar at 74 deg. F.). Stays tough down to −13 deg. F. Has high heat distortion point, superior surface gloss, and excellent color. Economy, color, and strength are features of this lawn mower wheel molded of TMD-2155.



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# Patching Metal Fenders with Reinforced Plastic

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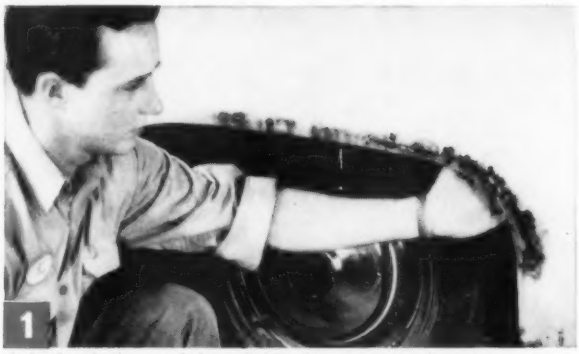


A fender that's rusted through like this can really depreciate a car's value. Besides spoiling the appearance, it costs a lot to repair with conventional methods and materials.

While the damaged area is being heated after cleaning by solvent and sanding (background), the glass cloth patches are cut to size and the BAKELITE Epoxy Resin is mixed with its hardener.

Layers of glass cloth saturated with the resin mix are set in place and shaped roughly to conform to the section being repaired. Several layers can be built up to fit required contours.

Heating with infra-red lamps causes the resin-hardener mixture to set. This operation takes about fifteen minutes. Shrinkage is no problem with BAKELITE Epoxy Resins. Patch holds fast to metal base.

Final operation before painting involves usual procedure of sanding the glass-cloth—BAKELITE Epoxy Resin laminated patch. Patch could also be machined or drilled. Paint is applied as with metal.

It took just a little over an hour. It saved 70% of the cost of doing the job with conventional materials and methods. This lamination of BAKELITE Brand Epoxy Resins provides a new method of patching rusted or dented sheet metal with comparable results.

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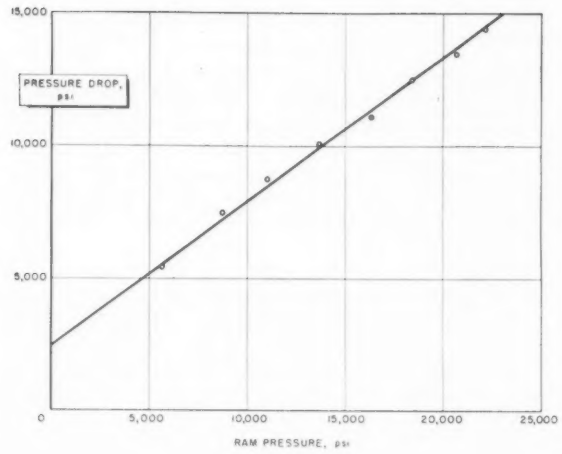


Fig. 8—Total pressure drop across cylinder, plotted against injection ram pressure

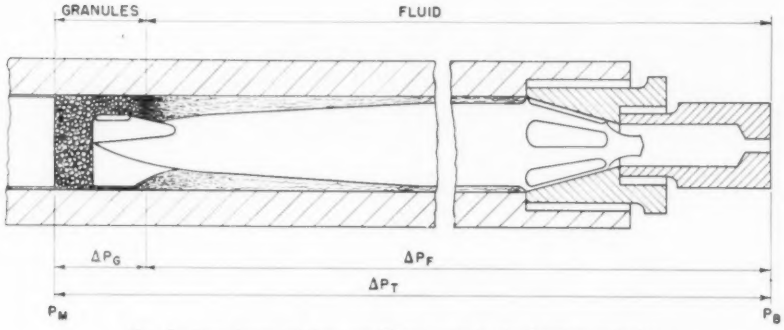


Fig. 9—Two types of flow conditions exist in the heating cylinder

termined by the value of $E$ that has been chosen.

The surface area of the slab of plastic in the heating cylinder

$$S = 1\,\pi\,(d_1 + d_2) \qquad \text{Eq. 9}$$

and the volume

$$V = \frac{1\,\pi\,(d_1^2 - d_2^2)}{4} \qquad \text{Eq. 10}$$

so that the surface to volume ratio is

$$\frac{S}{V} = \frac{4\,\pi\,1\,(d_1 - d_2)}{1\,\pi\,(d_1^2 - d_2^2)} = \frac{4}{d_1 - d_2} = \frac{2}{a} \qquad \text{Eq. 11}$$

The contact time at rated output in the heating cylinder is simply the volume divided by the rated output. With appropriate units the equation is

$$t = \frac{225\,V_P}{Q_R} \qquad \text{Eq. 12}$$

Eq. 8 becomes

$$\frac{\alpha\,V_P}{225\,(5-n^2)\,Q_R} \cdot \frac{S^2}{4\,V^2} = K_R \qquad \text{Eq. 13}$$

and

$$Q_R = \frac{\alpha\,S^2}{900\,K_R\,(5-n^2)\,V_P}$$

or

$$Q_R = K\,\frac{S^2}{V} \qquad \text{Eq. 14}$$

From this relationship it is possible to determine the influence of size on the rated output. By calculating the (surface)$^2$ to volume ratio and dividing the equation by $S^2/V$, a value of $K$ will be obtained. This value of $K$ will depend upon the value of $E$ chosen, the material, and the effectiveness of the particular design in heating the polymer. With the same material and at a constant $E$, $K$ will be a measure of the performance of the particular design of heating cylinder. It has been found on further calculations that this holds for a cylindrical tube of plastic as well as a slab.

## Pressure Drop

Since the purpose of the heating cylinder is two-fold, a complete evaluation must include more than just the heating characteristics. In an improvement in the heating cylinder, the percentage of the ram pressure left at the nozzle is just as important as the temperature of the plastic. A method of measuring and interpreting these pressure losses has been devised which can aid in studying the effects of heating cylinder design on pressure losses.

To measure the pressure losses in the heating chamber, a special fixture was built which contained a variable restriction to simulate the effects of the back pressure exerted on the heating chamber by the mold passages. An electronic pressure gage (5) was mounted ahead of this restriction to measure the back pressure. Another pressure gage was installed to measure the hydraulic pressure delivered to the ram. The frictional losses in the packings of the hydraulic cylinder may safely be neglected. An electrical timer was connected to the

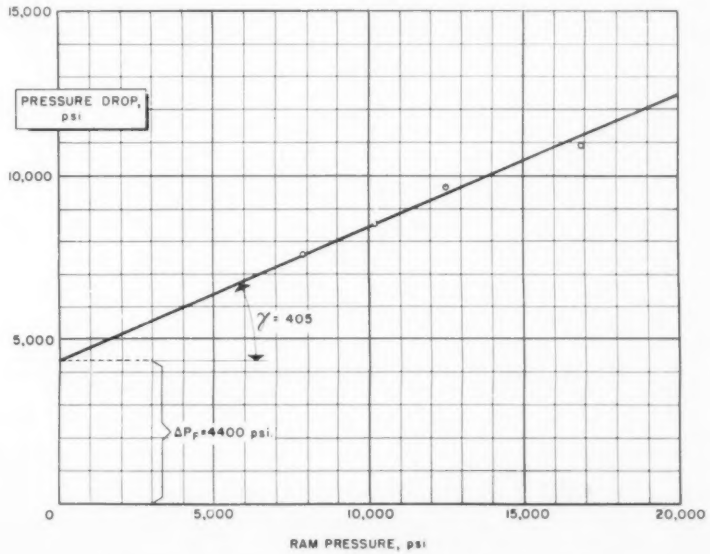


Fig. 10—Graph from experimental results, discussed on p. 236

ram to measure the speed of its travel and, therefore, the average rate of plastic flow. A thermocouple was also mounted in the nozzle to record the plastic temperature. See Fig. 7 for diagram of apparatus.

All of the tests were made at a constant cycle to eliminate any variations in plastic temperature. The heaters were controlled at 500° F., the total cycle was 2 min., and the shot size was set at the rated shot capacity of the machine. After obtaining a uniform cycle, the ram pressure and back pressure were recorded at a specific flow rate. The ram pressure was then changed to another value and the nozzle restriction adjusted to maintain the same flow rate. This was repeated for different ram pressures. Total pressure drop across heating cylinder was plotted against ram pressure as in Fig. 8.

If this graph is viewed in terms of fluid flow through a channel, it is immediately obvious that there is something wrong. It is known that the flow rate will depend upon the pressure drop along the channel and that when this pressure drop is changed the flow rate will also change. The points on Fig. 8 were taken at the same flow rate. Consequently, the pressure drop should be constant, but it isn't. Therefore, the pressure drop through the heating cylinder is dependent upon the flow rate and also upon the ram pressure or the hydrostatic pressure on the polymer. To find a rational explanation, it is necessary to look further into what goes on inside the heating chamber.

**Table I—Temperature Variations at E=0.80**

| Heater setting | Average plastic temp. | Approximate temperature variations |
|---|---|---|
| °F. | °F. | °F. |
| 450 | 375 | 150 |
| 500 | 415 | 170 |
| 550 | 455 | 190 |
| 600 | 495 | 210 |

Figure 9 shows that there are two distinct types of flow conditions that exist in the heating chamber. One is the movement of the granules through the rear portion of the heating chamber by the pressure of the ram, the other type is the viscous flow of the molten polymer.

The polymer starts as cold granules at room temperature and as it progresses through the heating cylinder its temperature increases. Once the material is molten, its viscosity will also vary along the length of its flow path. Because of the temperature variations there is no value of viscosity that can be assigned to the polymer in the heating chamber. An average viscosity could probably be computed as some function of the temperature distribution in the cylinder. Since the machine is run at uniform conditions at all times, the temperature distribution was considered to be a constant.

The pressure losses through the granular zone will be dependent on coefficient of friction between the cylinder wall and granules, the surface area in contact with the granules, and the applied force.

Spencer and Gilmore (6) found that under static conditions the frictional effects of polystyrene granules in a steel cylinder could be expressed by the following relationship:

$$P_d = P_m e^{\frac{-4 u L_0}{D}} \qquad \text{Eq. 15}$$

where e is the base of the natural logarithms = 2.718, $P_m$ is the ram pressure, $P_d$ is the pressure at the forward moving end of the granular zone, $L_0$ is the length of the uncompacted granules, D is the diameter of the granular zone, and $u$ is the coefficient of friction between the polymer and the steel.

Assuming that these conditions approximately represent the kinetic conditions, the pressure drop through this granular zone would be expressed as

$$P_m - P_d = \left(1 - e^{\frac{-4 u L_0}{D}}\right) P_m \qquad \text{Eq. 16}$$

The exact values of the constants are not known for heating cylinders. The quantity

$$\left(1 - e^{\frac{-4 u L_0}{D}}\right)$$

is set equal to some constant $\gamma$ and $\gamma$ is a measure of the frictional drag on the granules. So

$$P_m - P_d = \Delta P_G = \gamma P_m \qquad \text{Eq. 17}$$

and the pressure drop through the granules is simply proportional to the ram pressure. The total pressure drop in the heating cylinder will be the sum of the pressure drop through the granules and the pres-

(*To page* 236)

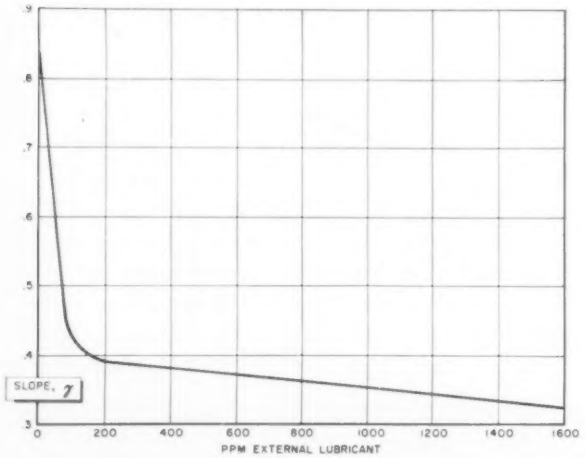


Fig. 11—Pressure drop versus external lubricant. See p. 238

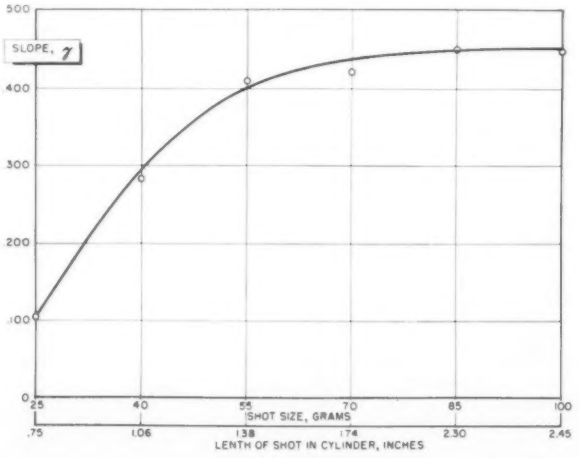


Fig. 12—Pressure drop versus shot size. See p. 238

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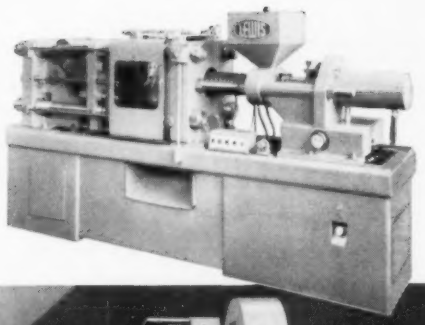

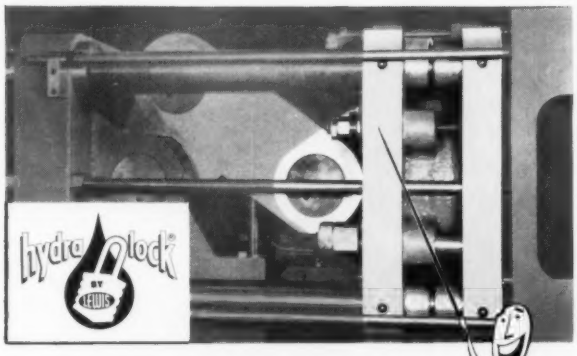


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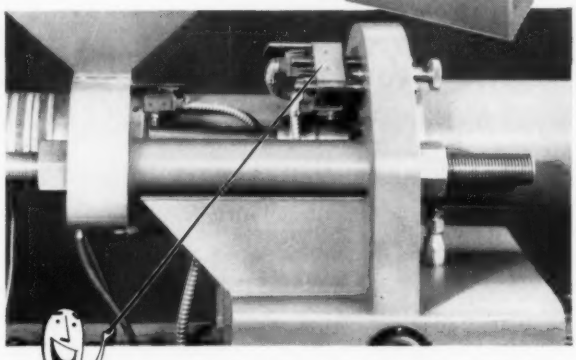

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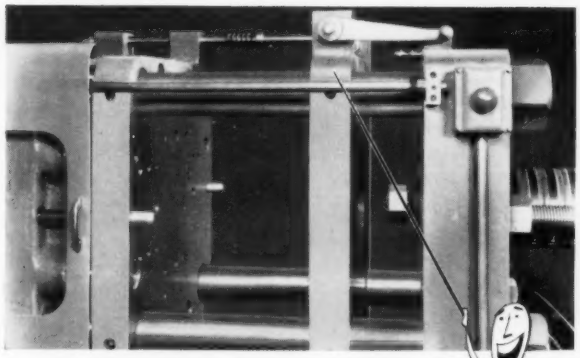

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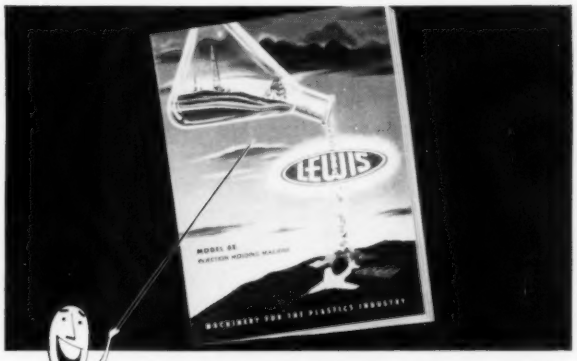


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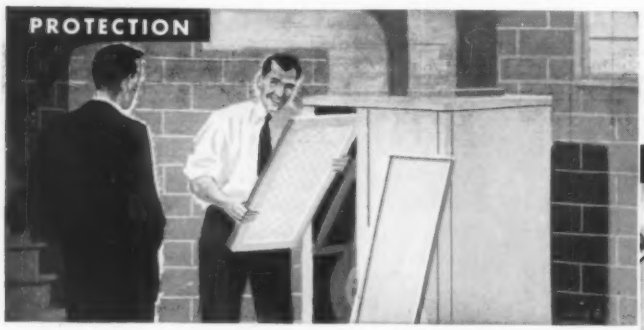


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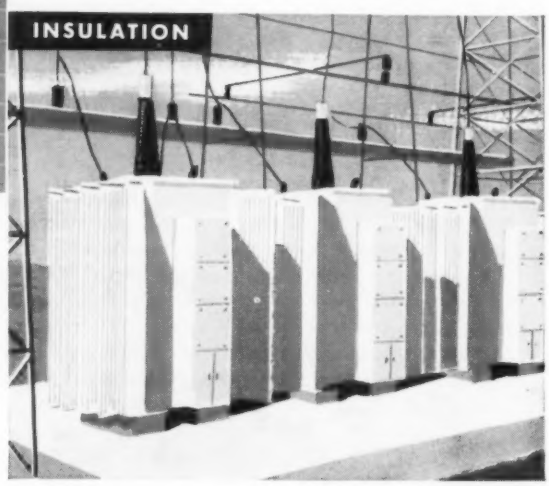


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PLASTICS*
TECHNICAL SECTION: Dr. Gordon M. Kline, Technical Editor

# High-Temperature DURABILITY of LAMINATES

by GEORGE E. POWER†

**Laminated sheets were tested for flexural strength, loss of weight, and perpendicular dielectric strength at temperatures ranging from 125 to 250° C. and were exposed for times up to 32 days. Materials included NEMA Grades XX (phenolic-paper), C (phenolic-canvas), N-1 (phenolic-nylon), G-5 (melamine-glass), G-7 (silicone-glass), AA (phenolic-asbestos), and G-1 (phenolic-glass), as well as experimental laminates made of glass fabric and heat-resistant phenolic, epoxy, diallyl phthalate, and silicone resins. It is concluded that heat resistance can be defined only in terms of the behavior desired at the anticipated temperature. Characteristics of resins with respect to weight loss, softening, decomposition, and crazing are given. These are presented in tabular form and in three-dimensional graphs that make it possible to visualize the entire time-temperature-property relationship. The high-temperature phenolics are seen to be promising and the epoxy and diallyl phthalate resins are shown to be highly craze resistant.**

IT IS common practice now to employ, or attempt to employ, plastics at temperatures far above those considered feasible only a few years ago. Place (1)[1], as recently as 1940, stated that his own studies might be of limited usefulness "since the number of applications (of laminates) influenced by high temperatures is small." Two factors have acted since that time to change the situation drastically. One is the great interest in jet aircraft and rocket-propelled craft in which the very nature of the undertaking requires contact with high temperatures. The other factor is the advent of basic raw materials, first glass fibers then silicone resins, which have made it possible to advance into the high temperature area of electrical devices.

As these fields of interest have developed, various investigators have studied the effect of temperature on plastic laminates, in order to develop criteria for their use. Place (1) studied the effect of heat on room-temperature mechanical and electrical properties. He concluded that materials of that period should not be investigated above 250° F. (120° C.), because of decomposition effects. In 1944, Carswell and Nason (2) conducted extensive tests of mechanical properties at temperatures up to 160° C. Their studies added the factor of measurement at the elevated temperature. Thus, the concept of "cold" properties, i.e., measured at room temperature after exposure to a higher temperature, and "hot" properties, i.e., measured at the elevated temperature, is added.

Hausmann, Parkinson, and Mains (3) studied laminates exposed to 225° C., tested at room temperature, and elaborated the hot testing method by the use of a hot oil bath, ranging in temperature up to 90° C. Norelli (4,5) further developed apparatus for testing hot up to 200° C. This equipment was precisely controlled and enabled him to obtain data over a wide range of temperatures. Many investigators are now equipped with devices that will allow mechanical strength measurements in the hot state at temperatures up to 300° C. (6, 7, 8, 9, 10). Hand and Winans (11) and Place (12) have reported on electrical properties tested at temperatures up to 250° C. One may thus reasonably expect plastics materials to be evaluated at elevated temperatures as a matter of common procedure in the future.

Present studies have already shown that simple decomposition may not be the limiting factor in high temperature operation. Virtually every investigator has noticed "softening" of the plastic resin at a point that may be far below the decomposition point. This is especially notable in some silicone resins for which the difference between the decomposition point and the softening point may be as much as 200° C. Indeed, Fried, Winans, and Sieffert (9) select as a criterion that point at which the "hot" mechanical strength falls to 50% of its room temperature ("cold") mechanical strength. Hopkins (13) was successful in raising this point to 200° C. for glass fiber-silicone laminates and Hoffmann (14) reported similar results. In both cases, the improved hot flexural strength rested upon proper choice of glass fabric. Since the mechanical strength of silicone resins is somewhat low to begin with, and undergoes additional softening further upon heating, their usefulness in some mechanical applications is limited.

The search for other heat-resistant resins has thus continued, with diallyl cyanurate (15) and certain phenolic types (16) becoming of interest, the latter because of their potential low cost.

Several excellent criteria for an in-

* Reg. U. S. Pat. Off.
† Senior Project Engineer, The Formica Co.
[1] Numbers in parentheses link to references at end of article, p. 240.

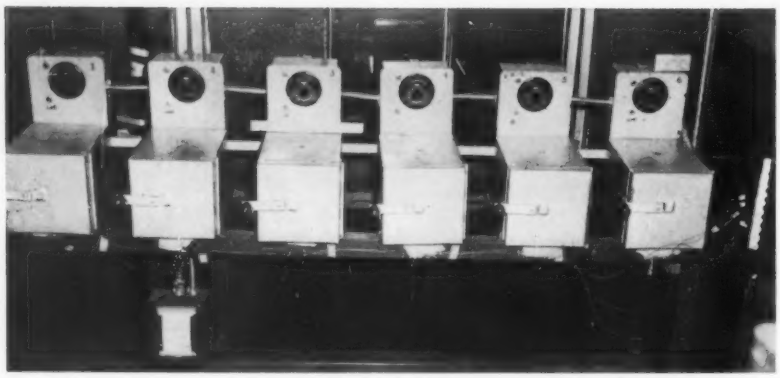

Fig. 1—Exposure ovens. Temperature of No. 1 is 125° C., increasing by 25° C. increments per oven up to 250° C. in No. 6. Dials on each oven operate input timers which regulate temperature. No. 6 is equipped with a thermostat; pilot light shows at top; at far right is part of thermocouple selector panel. Large switch below ovens controls entire unit

dex of heat resistance have been proposed (9,10) and some test methods already have been established by the A.S.T.M. (17,18). All such criteria are limited in usefulness in that they are aimed at defining heat resistance from a particular viewpoint. The engineer who wishes a rocket component to operate 3 min. at 700° C. has a concept of heat resistance totally different from the transformer designer who expects to operate only at 180° C. but for periods up to 20 years.

The studies reported in this paper were undertaken to: 1) develop simple, inexpensive equipment for prolonged high temperature testing; 2) present test results in a manner that may be useful to as many designers as possible, regardless of their particular aims; and 3) evaluate some of the more promising phenolics.

## Test Method and Apparatus

The laminated materials were exposed to temperatures of 125, 150, 175, 200, 225, and 250° C. for short periods (0 to 3 days) and for long periods (4 to 32 days), and then cooled to room temperature. Testing of the particular property under consideration was then carried out at room temperature and at the exposure temperature.

Exposures were carried out in a bank of small ovens (Fig. 1). The internal dimensions of each oven were 6 by 6 by 9 in. deep. Each oven consisted of a metal shell, surrounded by a second shell. The space between the inner and outer wall was 1 in. and was filled with an insulating material. The insulation was chosen to keep the exterior wall at a safe temperature, but heat loss through the walls was especially desired, since temperature control depended upon this condition. On the floor of each oven were two strip heaters (125 w. each), which were connected in parallel to a 110-v. source. Each oven was fitted with an input timer which operated on a 30-sec. cycle. By adjustment of this timer, the input to the oven could be regulated between 100% (250 w.) and 0 percent. Thus, electrical input could be balanced against heat loss through the walls and when steady state conditions were reached the desired temperature could be maintained. Due to fluctuations in the line voltage, it was found desirable to place a thermostat in one oven (the 250° C. oven was chosen). The other units were then balanced against it with input timers.

Baffles were placed above the strip heaters to regulate convection currents in the interior; a small vent at the top allowed air passage, slowly. The door at the front was fitted with asbestos strips to prevent excess air entry, but not to prevent it completely. Each oven was fitted with a thermocouple which operated through a selector switch to a portable potentiometer. Exploration throughout the ovens with other thermocouples revealed that temperature variation was approximately ±5° C. up to 200° C. and about ±8° C. at 225 and 250° C. This was the extreme variation; the samples on wire trays near the geometrical center were probably not subjected to this variation. Precautions were taken to see that direct radiation from the heaters did not fall upon the test specimens.

The oven for testing at the high temperatures was approximately 30 in. high by 26 in. wide by 20 in. deep. All walls were insulated by 4 in. of rockwool contained between metal shells similar to a typical electrical

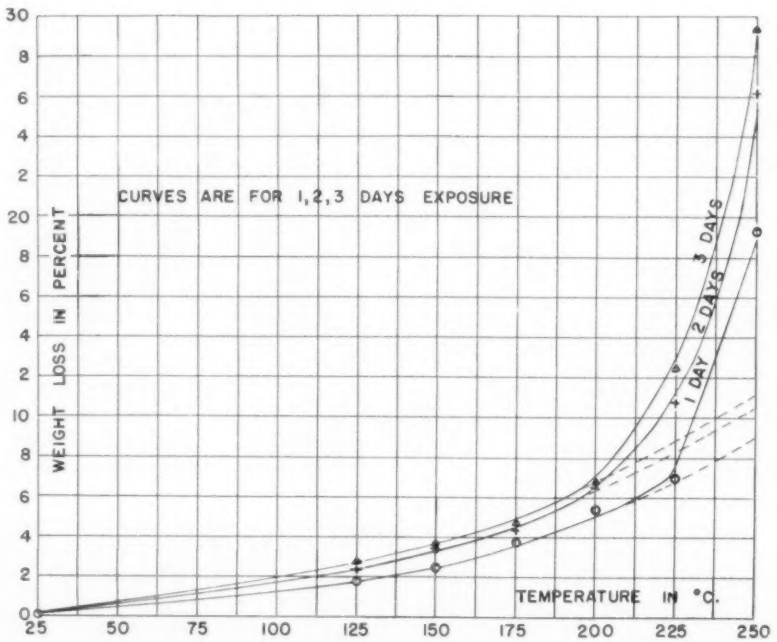


Fig. 2—Weight loss versus temperature for grade XX laminate

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refrigerator design. Strip heaters (ten 250-w. units) were mounted on the inside wall of the metal shell. Another wall (⅛ in. thick asbestos board) was placed inside the strip heaters and separated from them by about 1 inch. A squirrel-cage turbine-type fan blade caused air to circulate throughout the oven and particularly over the strip heaters. This oven was provided with holes on the top and bottom 1¼ in. in diameter through which were inserted round rods for applying loads to the test specimen. The oven was provided with a door in the front (8 by 10 in.), which contained a glass window about 6 in. in diameter.

In operation, this oven moved between the upright columns on the test machine by means of an angle iron track. Steel rods extended into the oven from the upper and lower crosshead. Suitable jigs were attached to these rods and thus loaded the specimen. The oven was supported by the metal track and was not in contact with the testing machine or any parts of the test jig. In practice, the oven could be raised to 250° C. in approximately 45 minutes. Maximum temperature difference in the oven at 250° C. was ±3° C.

Flexural specimens were ⅛ in. thick by 1 in. wide by 3 in. long; the 3-in. direction was parallel to the length of the fabric. Testing was in accordance with ASTM D 790-45T, using a 2-in. span and a 60,000-lb. universal testing machine. These same specimens were used to measure weight loss. Each specimen was weighed to the nearest 0.001 g. before and after exposure; weight loss was expressed as a percentage of the original weight. Perpendicular dielectric strength (short-time) was measured in accordance with ASTM D 149-44, except that specimens were tested in air rather than in oil. Specimen size was 6 by 6 by 1/32 inch.

## Materials

In order to gain experience in the mechanical test procedures and to obtain a basis for comparison for other laminates, a series of standard laminates was tested. This series included NEMA grades XX, C, N-1, G-5, G-7, AA, and G-1. Details of their composition are given in Table I, below and p. 144.

Following the testing of the NEMA grades, a series of commercial resins was screened. At first, this was confined to general-purpose phenolics, but as the program progressed, many manufacturers offered heat-resistant phenolic resins for testing. Other

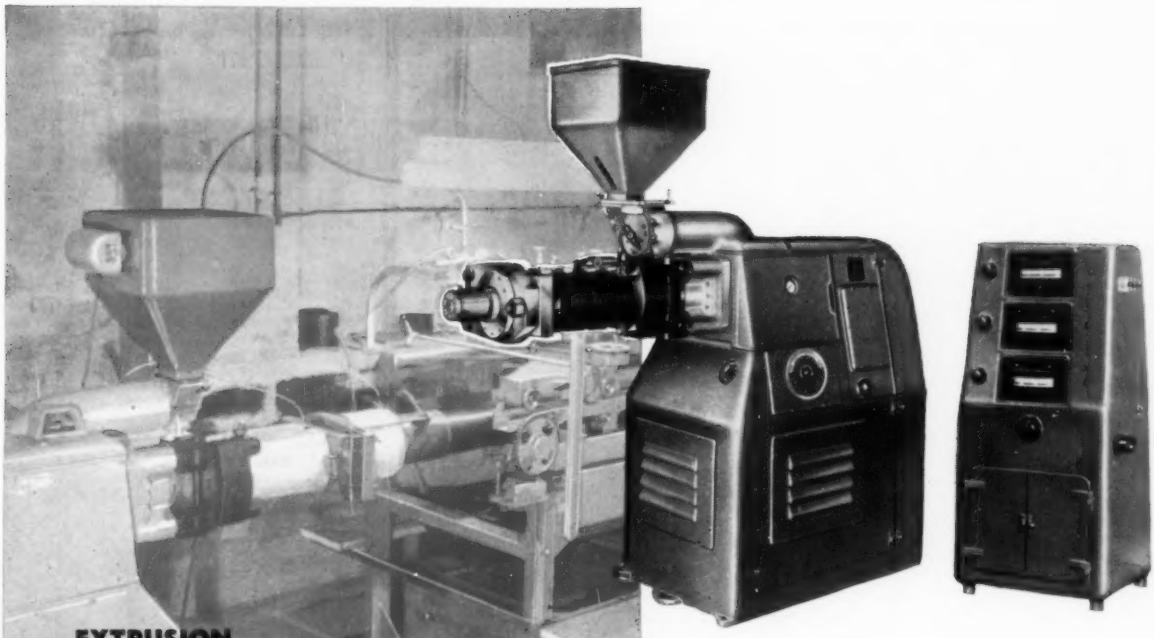
**Table I—Short-Time Exposure Tests on Standard N.E.M.A. Laminates and Special Experimental Laminates[a]**

| Description of Laminates | Exposure Temp. in ° C. | Weight Loss, % Exposure Time, Days 1 | 2 | 3 | Flexural Strength, Flatwise, p.s.i. Exposure Time, Days 0 Exposure | 1 Room | 1 Exposure | 2 Room | 2 Exposure | 3 Room | 3 Exposure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. 1. NEMA Grade: XX (Formica—XXN); base: Paper; resin: Phenolic; use: General Purpose. Orig. F. S.: 21,300 p.s.i. | 125 | 1.7 | 2.4 | 2.6 | 8,000 | 21,200 | 14,000 | 22,400 | 15,500 | 20,900 | 17,300 |
| | 150 | 2.5 | 3.4 | 3.5 | 7,650 | 20,200 | 15,900 | 21,600 | 15,700 | 23,900 | 15,800 |
| | 175 | 3.6 | 4.4 | 4.7 | 6,380 | 22,700 | 13,500 | 14,400 | 14,000 | 16,900 | 14,400 |
| | 200 | 5.4 | 6.4 | 6.7 | 3,960 | 16,000 | 8,750 | 21,300 | 7,800 | 15,000 | 7,000 |
| | 225 | 7.0 | 10.7 | 12.6 | 2,750 | Decomp. | | Decomp. | | Decomp. | |
| | 250 | 18.6 | 26.3 | 29.5 | 3,270 | Decomp. | | Decomp. | | Decomp. | |
| No. 2. NEMA Grade: C (Formica CN-16); base: Canvas Duck; resin: Phenolic; use: General Purpose. Orig. F. S.: 17,500 p.s.i. | 125 | 4.2 | 4.4 | 4.5 | | 17,200 | 11,100 | 16,600 | 10,800 | 15,100 | 10,900 |
| | 150 | 4.7 | 4.8 | 4.8 | 9,460 | 14,800 | 9,810 | 13,700 | 9,510 | 13,400 | 8,520 |
| | 175 | 5.7 | 5.7 | 6.1 | 10,300 | 10,900 | 8,360 | 10,200 | 6,830 | 7,900 | 4,650 |
| | 200 | 7.5 | 12.4 | 16.3 | 3,700 | 7,350 | 3,860 | 3,450 | 1,800 | 2,950 | 1,650 |
| | 225 | 32.1 | 41.9 | 44.9 | 3,150 | Decomp. | | Decomp. | | Decomp. | |
| | 250 | 50.3 | 57.2 | 56.9 | 4,250 | Decomp. | | Decomp. | | Decomp. | |
| No. 3. NEMA Grade: N-1 (Formica YN-25); base: Spun Nylon Duck; resin: Phenolic; use: Low Power Loss High I. R. Orig. F. S.: 12,700 p.s.i. | 125 | 0.15 | 0.40 | 0.41 | 8,290 | 13,600 | 8,110 | 13,000 | 7,940 | 13,100 | 8,460 |
| | 150 | 0.45 | 0.50 | 0.60 | 7,950 | 13,200 | 7,530 | 13,000 | 6,530 | 12,800 | 7,360 |
| | 175 | 0.49 | 0.85 | 0.98 | 7,150 | 11,900 | 6,180 | 11,400 | 6,580 | 11,000 | 6,570 |
| | 200 | 0.78 | 1.2 | 1.3 | 2,320 | 9,000 | 5,480 | 8,000 | 5,480 | 7,800 | 5,310 |
| | 225 | 1.1 | 1.8 | 2.0 | 650 | 5,400 | 4,080 | 4,950 | 4,340 | 5,200 | 4,180 |
| | 250 | 2.3 | 3.2 | 3.5 | 750 | 4,050B[b] | 2,390B | 4,350B | 2,480B | 3,250B | 2,500B |
| No. 4. NEMA Grade: G-5 (Formica FF-55); base: Square weave glass fabric, continuous, 6 oz.; resin: Melamine; use: Arc Resistance, Flame Resistance. Orig. F. S.: 56,100 p.s.i. | 125 | 0.34 | 0.44 | 0.44 | 40,100 | 48,800 | 45,800 | 46,600 | 40,400 | 44,100 | 43,000 |
| | 150 | 0.48 | 0.51 | 0.52 | 36,400 | 42,300 | 38,900 | 40,400 | 37,600 | 41,700 | 35,900 |
| | 175 | 0.59 | 0.62 | 0.63 | 32,900 | 34,200 | 30,800 | 33,700 | 28,800 | 31,700 | 28,100 |
| | 200 | 0.65 | 0.70 | 0.70 | 27,600 | 29,500 | 25,000 | 27,000 | 21,600 | 23,500 | 22,400 |
| | 225 | 0.72 | 0.78 | 0.78 | 25,000 | 20,500 | 17,700 | 19,500 | 17,400 | 18,900 | 16,300 |
| | 250 | 0.78 | 0.87 | 0.89 | 25,600 | 18,300 | 16,600 | 16,400 | 17,300 | 14,100 | 16,200 |
| No. 5. NEMA Grade: G-7 (Formica G-7-1); base: Square weave glass fabric, continuous, 3 oz.; resin: Silicone; use: Low Power Loss, Heat Resistance, Arc Resistance. Orig. F. S.: 34,800 p.s.i. | 125 | 0.10 | 0.14 | 0.17 | 23,700 | 33,400 | 25,400 | 34,500 | 24,500 | 35,100 | 25,100 |
| | 150 | 0.18 | 0.18 | 0.21 | 19,800 | 33,800 | 22,100 | 33,400 | 20,500 | 33,800 | 21,600 |
| | 175 | 0.26 | 0.27 | 0.30 | 18,200 | 34,200 | 20,400 | 34,300 | 19,500 | 33,800 | 21,100 |
| | 200 | 0.28 | 0.34 | 0.35 | 14,200 | 34,200 | 15,800 | 34,700 | 16,000 | 32,700 | 16,800 |
| | 225 | 0.40 | 0.44 | 0.48 | 12,400 | 34,300 | 14,300 | 33,100 | 14,600 | 32,700 | 15,600 |
| | 250 | 0.56 | 0.67 | 0.72 | 11,200 | 32,400 | 14,200 | 33,200 | 14,800 | 31,100 | 14,200 |
| No. 6. NEMA Grade AA (Formica AA-39); base: Asbestos Fabric; resin: Phenolic; use: Heat Resistance. Orig. F. S.: 20,600 p.s.i. | 125 | 0.25 | 0.25 | 0.24 | 15,800 | 20,300 | 17,400 | 23,600 | 17,900 | 19,600 | 17,700 |
| | 150 | 0.27 | 0.23 | 0.22 | 14,600 | 18,900 | 16,500 | 20,700 | 17,600 | 20,800 | 15,500 |
| | 175 | 0.31 | 0.27 | 0.28 | 15,900 | 19,400 | 16,200 | 17,400 | 18,000 | 17,300 | 17,200 |
| | 200 | 0.35 | 0.42 | 0.46 | 12,400 | 17,900 | 15,000 | 18,100 | 14,000 | 18,200 | 14,400 |
| | 225 | 0.72 | 0.92 | 1.1 | 12,200 | 15,600 | 12,900 | 14,400 | 11,900 | 13,200 | 10,200 |
| | 250 | 1.1 | 1.6 | 1.7 | 10,600 | 12,800 | 11,500 | 10,900 | 7,850 | 10,200 | 8,160 |

[a] Specimen size was 3" x 1" x 1/8" cut lengthwise. Specimens were exposed at temperatures and times shown, then brought to room temperature. Some specimens were then tested at room temperature (25° C.); these results are shown under column headed "Room." Duplicate sets were raised to the exposure temperature and tested; see column headed "Exposure." Original flexural strength shown in column 1 is for laminate as received, determined at 25° C. All values are averages of two tests, except as otherwise noted.

[b] B=blistered during exposure.

(Table I continued on page 144)



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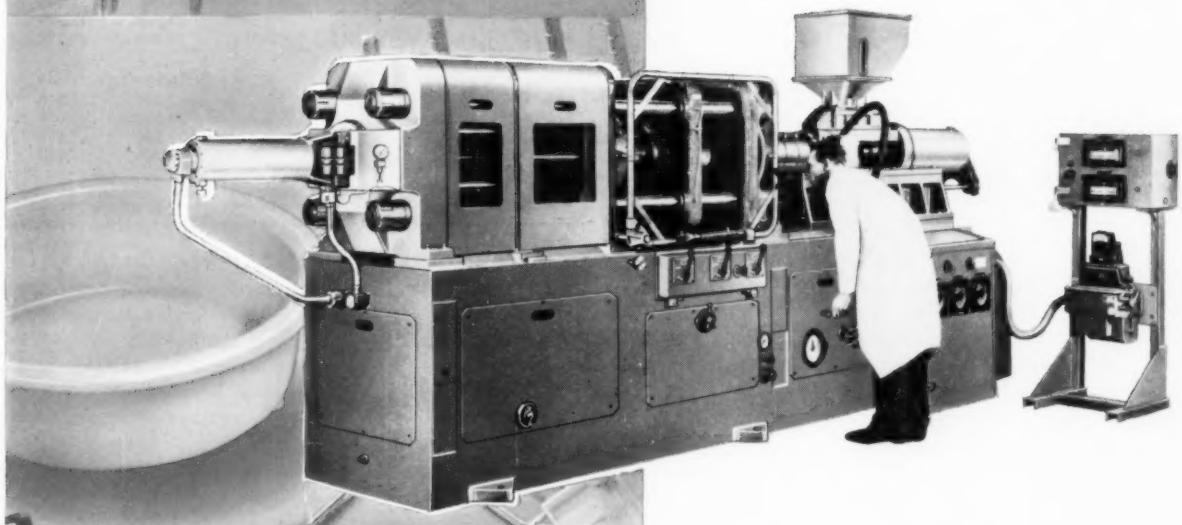

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## Table I—Short-Time Exposure Tests on Standard N.E.M.A. Laminates . . . etc; Continued from p. 142

| Description of Laminates | Exposure Temp. | Weight Loss, % Exposure Time, Days | | | Flexural Strength, Flatwise, p.s.i. Exposure Time, Days | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0 | | 1 | | 2 | | 3 | |
| | in °C. | 1 | 2 | 3 | Exposure | Room | Exposure | Room | Exposure | Room | Exposure |
| No. 7. NEMA Grade: G-1 (Formica FF-10); base: Square weave glass fabric, staple, 10 oz.; resin: Phenolic; use: Heat Resistance. Orig. F. S.: 29,500 p.s.i. | 125 | 2.7 | 2.7 | 2.7 | 22,200 | 30,000 | 24,800 | 28,900 | 25,500 | 30,200 | 26,000 |
| | 150 | 2.9 | 2.9 | 3.0 | 19,800 | 29,800 | 23,500 | 29,600 | 23,900 | 29,500 | 25,600 |
| | 175 | 3.4 | 3.4 | 3.5 | 18,200 | 28,100 | 24,300 | 26,900 | 24,700 | 27,400 | 24,000 |
| | 200 | 3.9 | 4.0 | 4.1 | 14,700 | 26,200 | 20,500 | 28,100 | 20,300 | 26,300 | 21,200 |
| | 225 | 4.1 | 4.4 | 4.2 | 15,300 | 25,900 | 21,600 | 24,300 | 21,600 | 22,300 | 21,000 |
| | 250 | 4.6 | 6.4 | 8.5 | 17,800 | 25,000 | 21,000 | 18,600 | 17,000 | 15,900 | 14,400 |
| No. 8. Experimental (Formica)[c]; base: Pyrolized HG-29 (Glass); resin: CIBA Epoxy; pick-up: 45%. Orig. F. S.: 62,600 p.s.i. | 125 | — | — | 0.14 | 13,800 | — | — | — | — | 60,700 | 19,200 |
| | 150 | 0.16 | 0.18 | 0.24 | 8,000 | 67,200 | 6,250 | 58,500 | 6,800 | 63,700 | 6,900 |
| | 175 | 0.21 | 0.24 | 0.31 | 8,030 | 70,700 | 9,020 | 64,200 | 7,820 | 70,000 | 8,470 |
| | 200 | 0.35 | 0.51 | 0.55 | 5,850 | 65,900 | 6,700 | 61,300 | 6,950 | 56,000 | 6,820 |
| | 225 | 0.78 | 1.5 | 1.9 | 4,320 | 68,300 | 4,430 | 67,300 | 4,210 | 67,300 | 4,260 |
| | 250 | 2.3 | 3.1 | 3.6 | 3,650 | 65,000 | 3,610 | 66,200 | 4,070 | 62,500 | 4,420 |
| No. 9. Experimental (Formica); base: Pyrolized HG-81 (Glass); resin: Shell diallyl phthalate; pick-up: 40%. Orig. F. S.: 41,700 p.s.i. | 125 | 0.28 | 0.27 | 0.35 | 16,100 | 51,000 | 13,500 | 57,600DT[d] | 17,000 | 58,100DT | 18,300 |
| | 150 | 0.44 | 0.47 | 0.52 | 10,700 | 47,800 | 9,800 | 33,500DT | 8,400DT | 45,400DT | 7,900DT |
| | 175 | 0.69 | 0.58 | 1.00 | 8,400 | 40,600DT | 7,000DT | 39,000DT | 8,000DT | 45,800DT | 9,700DT |
| | 200 | 1.6 | 1.5 | 2.3 | 3,500DT | 44,200DT | 7,400DT | 45,700DT | 9,300DT | 33,900DT | 10,500DT |
| | 225 | 6.2 | 11.6 | 16.8 | 3,000DT | 30,100DT | 9,700DT | 21,600DT | 11,700DT | 19,400DT | 12,300DT |
| | 250 | 23.4 | 23.4 | 24.9 | 2,600DT | 6,200DB[e] | 3,100DB | 3,900DB | 2,000DB | 4,200DB | 1,900DB |
| No. 10. Cincinnati Testing & Research Lab. laminate[c]; base: 181 Fabric (Glass); resin: 91-LD Phenolic; pick-up: approx. 35%; Orig. F. S.: 48,800 p.s.i. | 125 | 0.13 | 0.16 | 0.28 | 43,100 | 51,200 | 42,000 | 50,800 | 42,800 | 47,200 | 41,800 |
| | 150 | 0.15 | 0.17 | 0.31 | 43,600 | 49,900 | 39,100 | 48,100 | 37,700 | 46,600 | 39,700 |
| | 175 | 0.20 | 0.27 | 0.42 | — | 51,700 | — | 48,200 | — | 47,200 | — |
| | 200 | 0.34 | 0.33 | 0.49 | 39,400 | 45,500 | 39,900 | 46,800 | 39,500 | 42,300 | 41,500 |
| | 225 | 0.42 | 0.43 | 0.67 | 39,500 | 46,200 | 38,100 | 44,900 | — | 47,600 | 48,100 |
| | 250 | 0.61 | 0.74 | 0.96 | 38,900 | 45,100 | 35,800 | 46,100 | 33,200 | 44,600 | 39,800 |
| No. 11. Experimental[c] (Formica); base: Pyrolized HG-81 (Glass); resin: Bakelite Heat-Resistant Modified Phenolic; pick-up: 45%. Orig. F. S. 61,900 p.s.i. | 125 | 0.9 | 1.0 | 1.3 | 43,700 | 59,000 | 49,600 | 63,800 | 52,700 | 63,600 | 50,500 |
| | 150 | 1.6 | 1.8 | 1.8 | 32,500 | 62,800 | 42,600 | 57,800 | 53,900 | 61,200 | 55,300 |
| | 175 | 2.5 | 2.7 | 2.8 | 31,500 | 54,500B | 53,200 | 60,500B | 60,500 | 48,700B | 54,600 |
| | 200 | 2.9 | 2.9 | — | 35,300B | 40,400B | 47,300B | 40,300B | 32,900B | 38,000B | 37,900B |
| | 225 | 3.3 | 3.3 | 3.5 | 45,600B | 39,000B | 31,400B | 46,100B | 39,400B | 39,600B | 38,100B |
| | 250 | 3.0 | 3.1 | 2.8 | 16,800 | 42,000B | 33,700B | 33,900B | 32,600B | 32,200B | 28,400B |
| No. 12. Experimental (Formica); After Baked[c]; base: Pyrolized HG-81 (Glass); resin: Bakelite Heat-Resistant Phenolic; pick-up: 35%; Orig. F. S.: 55,500 p.s.i. | 125 | 0.37 | 0.45 | 0.48 | — | 56,000 | 43,400 | 60,800 | 44,500 | 62,800 | 43,600 |
| | 150 | 0.36 | 0.43 | 0.44 | — | 53,500 | 49,200 | 58,400 | 46,800 | 64,100 | 46,100 |
| | 175 | 0.32 | 0.48 | 0.49 | 44,000 | 54,500 | 46,600 | 60,000 | 44,300 | 55,400 | 49,500 |
| | 200 | 0.57 | 0.53 | 0.57 | 46,000 | 54,800 | 43,300 | 53,800 | 45,000 | 51,400 | 42,500 |
| | 225 | 0.53 | 0.49 | 0.84 | 34,000 | 48,800 | 43,900 | 51,100 | 42,700 | 52,500 | 41,400 |
| | 250 | 0.83 | 1.1 | 3.1 | 35,500 | 49,500 | 43,100 | 49,600 | 37,600 | 29,800 | 29,200 |
| No. 13. Experimental (Reichhold Chem., Inc.)[c]; base: 181, Volan; resin: Plyophen Heat Resistant Phenolic; pick-up: approx. 35%; Orig. F. S.: 64,600 p.s.i. | 125 | — | — | — | — | — | — | — | — | — | — |
| | 150 | — | — | — | 49,700 | 64,900 | 54,200 | — | — | 60,100 | 45,600 |
| | 175 | — | — | — | 51,300 | 56,800 | 46,400 | — | — | 61,300 | 51,000 |
| | 200 | — | — | — | 45,500 | 52,200 | 49,800 | — | — | 54,800 | 44,600 |
| | 225 | — | — | — | 36,900 | 52,200 | 45,200 | — | — | 52,300 | 43,800 |
| | 250 | — | — | — | 31,400 | 49,700 | 42,800 | — | — | 49,200 | 35,900 |

[c] Values are for one specimen only.
[d] DT=delaminated during flexural test.
[e] DB=delaminated during exposure bake.
[f] Values for 1 and 2 days exposure are for one specimen only.

resins were also screened, such as polyesters, including triallyl cyanurate and diallyl phthalate types, and epoxy varieties. The role of the glass fabric was also evaluated, especially the difference between square weave and satin weave. The ratio of resin to glass was also investigated.

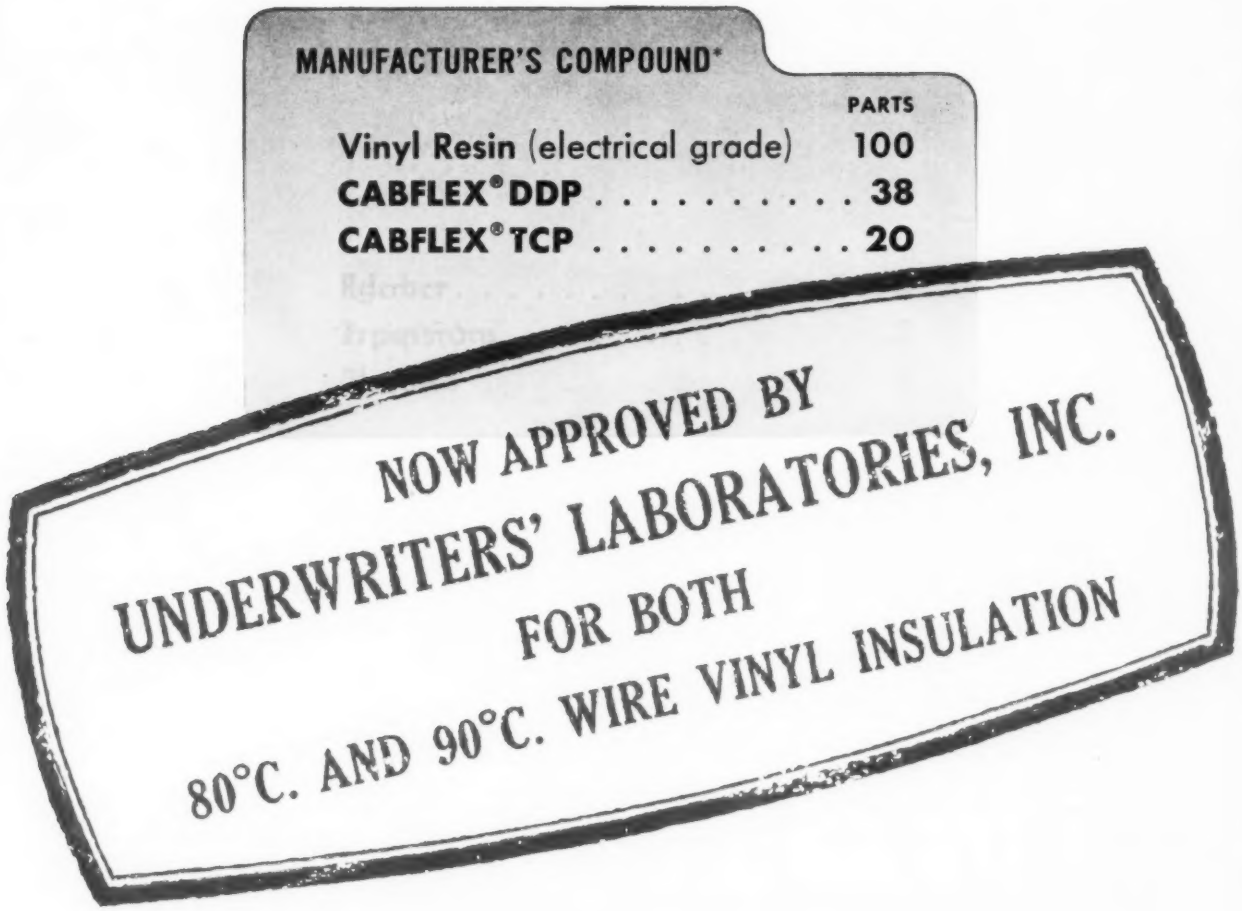
From the screening tests the most promising combinations of glass fabric and resins were selected for long-time testing. Final choices included a silicone resin, three varieties of heat-resistant phenolic resins, and one general-purpose phenolic resin whose heat resistance was considered to be above normal. HG-81 glass fabric was selected as the most satisfactory fabric because of the high mechanical strength it produced. This fabric was "pyrolized" or "caramelized" before use in the laminates. This process consists of removing objectionable oils by a short exposure to a temperature of about 600° F. Such treatment improves the bond between resin and glass very greatly. The optimum resin content was found to be between 32 and 37 per cent. In the dielectric strength evaluations, a series of phenolic resins, one epoxy resin, and one diallyl phthalate resin were investigated.

Laminates were made 18 by 20 by $\frac{1}{8}$ in. for flexural strength testing. Sheets 18 by 20 by $\frac{1}{32}$ in. were used for perpendicular dielectric strength tests. In all, some 65 laminates were made and tested. Only the more interesting results are reported here.

### Short-Time Tests

Various investigators have defined criteria for the maximum temperature at which a plastic material may be used without deterioration. Mostly, this definition has been in connection with long-time operation. It is the purpose of this discussion to explore both long- and short-time operations, examining behavior both at normal and elevated temperatures and in so doing, to establish the general nature of the material under consideration rather than to define specific points within the area studied. It is hoped that such considerations will serve to orient the user with the material of his choice and permit him to estimate the risks involved in following various paths.

Everyone is agreed that total decomposition is the uppermost limit of usefulness. Although it is perfectly possible, in some instances, for the resin to disintegrate entirely and yet leave behind the inorganic base material that may still function satisfactorily, we will consider decomposition of the resin to mean loss of usefulness. One of the simplest mea-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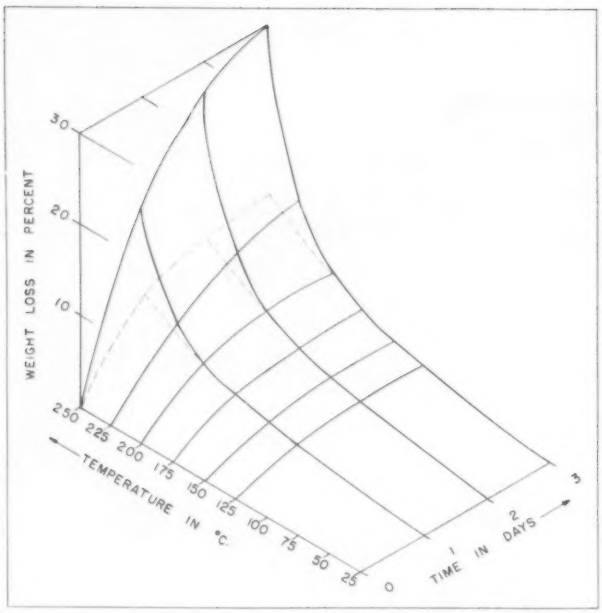
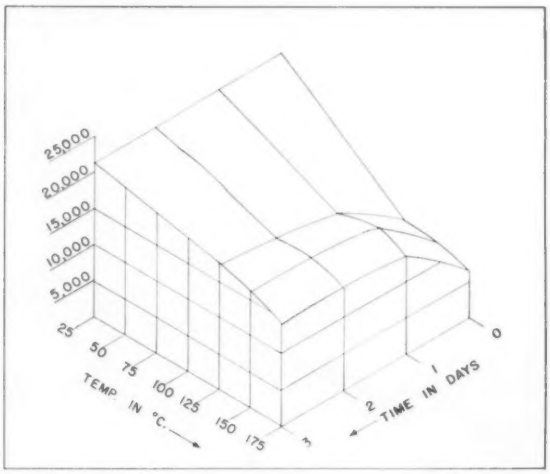



Fig. 3 (left)—Weight loss-time-temperature diagram for XX laminate

Fig. 4 (below)—Hot flexural strength-time-temperature three-dimensional diagram for grade XX laminate




sures of decomposition is weight loss. Sieffert and Schoenborn (10) have discussed the possibilities of this method thoroughly. Excessive weight loss indicates that decomposition is occurring. Small weight losses, especially at low temperatures, may merely indicate escape of slowly volatile matter.

A simple mechanical property that has many desirable features for studying resin behavior is flexural strength. Since specimens stressed as a simple beam have tensile, compressive, and shear forces acting upon them, one may be sure that the test represents many types of loading. In addition, two separate characteristics of the resin can be studied by measuring this property in the cold and hot states. The flexural strength measured at room temperature in the "as received" condition provides a basis for comparison under all other conditions. By observing changes in this property after exposure, another measure of deterioration is gained.

The flexural strength measured at an elevated temperature may also provide a measure of deterioration, but more important, provides a measure of the degree of cure of the resin and of the softening of both the resin and the base material. All investigators have observed this phenomenon; Fried, Winans, and Sieffert have presented an especially clear discussion (9).

By studying the changes in these properties (weight loss, cold flexural strength, hot flexural strength) it is possible to trace the laminate through many important changes. It should be borne in mind that a rating of heat resistance obtained by mechanical studies may not give any indication of heat resistance in terms of electrical properties, chemical resistance, or dimensional stability. It will, however, provide a clear indication of overcure or undercure of the resin and will also discriminate between resins that soften greatly on heating and those which do not.

An examination of Table I, Laminate No. 1 (which is an example of the widely known grade XX, paper-phenolic) will illustrate the possibilities of these procedures. In the left-hand section of the table, weight loss versus time and temperature is shown. When exposed for one day the laminate lost 1.7% of its weight

**Table II—Loss of Weight After Long Time Exposure of Selected Laminates[a]**

| Laminate | Time of Exposure in Days | Loss of Weight in Percent, After Exposure to Temperature Shown | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125° C. | 150° C. | 175° C. | 200° C. | 225° C. | 250° C. |
| No. 14 | 4 | 0.12 | 0.20 | 0.27 | 0.34 | 0.42 | 0.52 |
| | 8 | 0.12 | 0.22 | 0.28 | 0.36 | 0.48 | 1.28 |
| | 16 | 0.24 | 0.29 | 0.39 | 0.52 | 0.55 | 1.37 |
| | 32 | | 0.42 | 0.49 | 0.66 | 0.74 | 1.93 |
| No. 15 | 4 | 0.25 | 0.36 | 0.42 | 0.54 | 0.67 | 0.84 |
| | 8 | 0.26 | 0.36 | 0.41 | 0.61 | 0.70 | 0.91 |
| | 16 | 0.41 | 0.48 | 0.54 | 0.79 | 0.97 | 2.90 |
| | 32 | 0.41 | 0.55 | 0.64 | 0.97 | 2.56 | 11.41 |
| No. 16 | 4 | 0.55 | 0.53 | 0.56 | 0.58 | 0.83 | 4.25 |
| | 8 | 0.53 | 0.51 | 0.59 | 0.71 | 0.92 | 4.43 |
| | 16 | 0.61 | 0.62 | 0.64 | 0.73 | 1.00 | 7.18 |
| | 32 | 0.75 | 0.85 | 1.19 | 1.75 | 7.00 | 16.10 |
| No. 17 | 4 | 0.31 | 0.60 | 0.71 | 1.20 | 1.54 | 1.78 |
| | 8 | 0.51 | 0.80 | 1.08 | 1.38 | 1.83 | 3.47 |
| | 16 | 0.59 | 0.86 | 1.14 | 1.42 | 1.68 | 5.65 |
| | 32 | 0.70 | 1.05 | 1.30 | 1.77 | 4.10 | 13.88 |
| No. 18 | 4 | 0.11 | 0.08 | 0.13 | 0.42 | 0.80 | 2.41 |
| | 8 | 0.09 | 0.07 | 0.22 | 0.64 | 2.32 | 7.70 |
| | 16 | 0.15 | 0.19 | 0.25 | 0.61 | 3.36 | 9.19 |
| | 32 | 0.24 | 0.38 | 0.49 | 3.89 | 5.17 | 8.48 |

[a] All values are averages of two tests.

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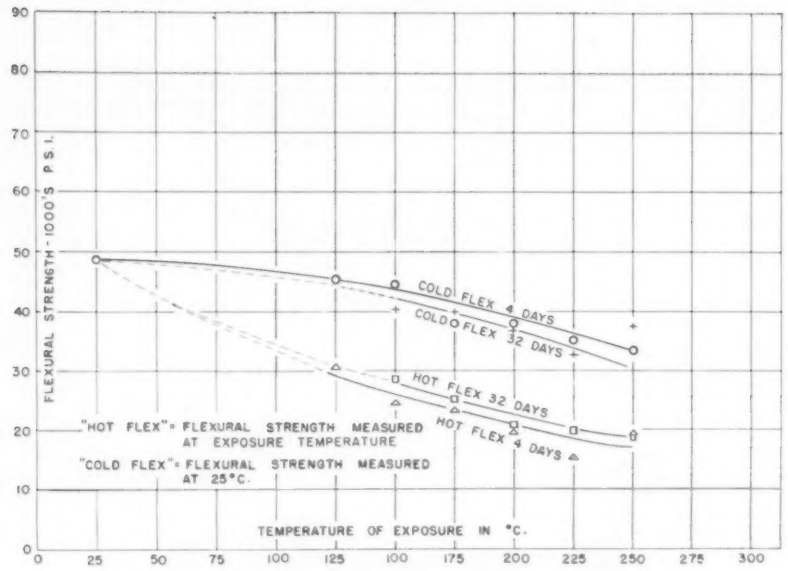
FLEXURAL STRENGTH - 1000'S P.S.I.
COLD FLEX 4 DAYS
COLD FLEX 32 DAYS
HOT FLEX 32 DAYS
HOT FLEX 4 DAYS
"HOT FLEX" = FLEXURAL STRENGTH MEASURED AT EXPOSURE TEMPERATURE
"COLD FLEX" = FLEXURAL STRENGTH MEASURED AT 25°C.
TEMPERATURE OF EXPOSURE IN °C.

Fig. 5—Flexural strength versus temperature for silicone-glass laminate No. 14

at 125° C. and 18.6% at 250° C. It will be noted that from 125 up to 225° C., this weight loss increased gradually, but at 250° C. a disproportionate loss occurred. This is shown graphically in Fig. 2, p. 140. The sharp rise in slope after 225° C. is easily noticed. This is akin to the critical thermal instability temperature of Sieffert and Schoenborn, although they have defined it more precisely. It is clear that grade XX cannot be exposed for even short times above 225° C. Examination of the weight loss for two and three days will show that disproportionate loss now occurs at 225° C. It is clear that these changes in slope merely indicate *excessive* deterioration. It is not implied that no deterioration is involved at lower temperatures. The point is, that short-time exposures even as high as 225° C. may be tolerated on such a material as grade XX. This could be important to a manufacturer who wishes to bake his equipment after assembly. Baking at 250° C. can not be tolerated; baking up to 24 hr. at 225° C. is permissible if only weight loss is considered; whereas baking up to 72 hr. seems feasible if the temperature is not above 200° C. If the expected life of the equipment is only a few hours, grade XX may be suitable for temperatures up to 225° C. Likewise, the risks for short times due to overloads may be evaluated.

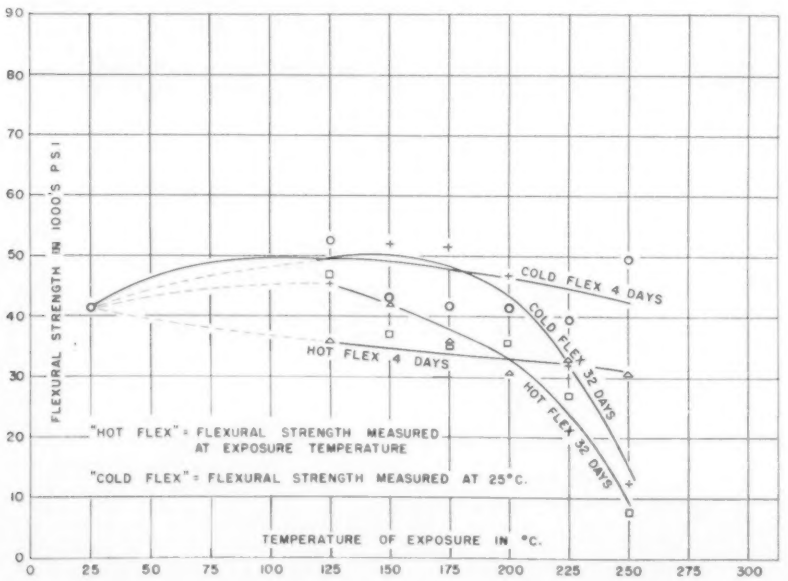
FLEXURAL STRENGTH IN 1000'S PSI
COLD FLEX 4 DAYS
COLD FLEX 32 DAYS
HOT FLEX 4 DAYS
HOT FLEX 32 DAYS
"HOT FLEX" = FLEXURAL STRENGTH MEASURED AT EXPOSURE TEMPERATURE
"COLD FLEX" = FLEXURAL STRENGTH MEASURED AT 25°C.
TEMPERATURE OF EXPOSURE IN °C.

Fig. 6—Flexural strength versus temperature for phenolic-glass laminate No. 15

Figure 3, p. 146, shows these data on a three-dimensional plot. Here a surface is developed which shows the user the nature of the regions in which he may work. The dotted lines above 200° C. show a projected surface which may be considered the normal behavior in terms of the characteristics below 200° C. Obviously, operation above 200° C. is to be avoided. The user may evaluate for himself what risk is involved if, because of emergency conditions, the material must operate in this high temperature region.

A study of the room-temperature flexural strength (Table I) sheds further light on the situation. At one-day exposure, this value is maintained up to 175° C. without loss. At 200° C., the strength drops noticeably but the part is still likely to be usable. By examining trends with time at constant temperature, a further estimate is obtained. For instance, at 125 and 150° C., there seems to be no loss of strength after three days as compared to zero days. At 175° C., there is a loss in strength after two and three days. Thus, prolonged exposure at 175° C. seems to be contra-indicated, but exposures up to 24 hr. do not appear to be critical. Furthermore, exposures up to several days at 175° C. would not necessarily render equipment inoperative, even though such exposure may be undesirable.

Finally, the hot flexural strength is of interest. Under "0 days" (Table I) is shown the manner in which the material softens upon heating. The flexural strength decreases sharply upon heating. Note, however, that the hot flexural is improved considerably by exposure up to 24 hr. at 125, 150, 175° C. It is apparent that the resin has not been fully cured. Exposure at 125° C. for 24 hr. might be beneficial for those who wish a laminate to remain rigid at elevated temperatures. The idea of "heat treating" of plastics is not new, but

## Table III—Flexural Strengths of Selected Laminates After Long Time Exposure[a]

| Description of Laminates | Exposure Time in Days | FLEXURAL STRENGTH, FLATWISE, AFTER EXPOSURE TO TEMPERATURES SHOWN, p.s.i. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 125° C. | | 150° C. | | 175° C. | | 200° C. | | 225° C. | | 250° C. | |
| | | Room | Exposure | Room | Exposure | Room | Exposure | Room | Exposure | Room | Exposure | Room | Exposure |
| No. 14. Experimental (Formica); base: Pyrolized HG-81; resin: Dow-Corning Silicone (35%); cure: 3 hr. at 250° C. Orig. F. S.: 48,000 p.s.i. | 4 | 45,600 | 31,300 | 44,500 | 24,700 | 38,000 | 23,400 | 38,200 | 19,300 | 35,300 | 15,500 | 33,500 | 19,400 |
| | 8 | — | 33,200 | 45,300 | 21,400 | 43,600 | 26,600 | 37,200 | 16,500 | 39,300 | 17,500 | 33,400 | 18,800 |
| | 16 | 46,500 | 29,800 | 44,200 | 26,300 | 44,500 | 26,100 | 40,500 | 27,200 | 35,000 | 24,400 | 38,300 | 19,100 |
| | 32 | — | — | 40,500 | 28,900 | 40,000 | 25,200 | 37,000 | 20,600 | 32,200 | 19,800 | 37,500 | 19,700 |
| No. 15. C.T.L. Laminate; base: 181 Fabric (114); resin: 91-L-D Phenolic. Orig. F. S.: 41,600 p.s.i. | 4 | 52,500 | 35,600 | 43,000 | 42,200 | 41,900 | 36,100 | 41,500 | 30,800 | 39,400 | 32,800 | 49,500 | 30,900 |
| | 8 | 44,800 | 38,200 | 45,000 | 35,[illegible] | 45,800 | 35,400 | 45,500 | 34,000 | 45,500 | 30,700 | 41,500 | 38,000 |
| | 16 | 45,300 | 48,000 | 47,200 | 36,800 | 48,300 | 45,800 | 57,900 | 36,400 | 37,500 | 35,000 | 33,800 | 30,200 |
| | 32 | 45,100 | 46,800 | 53,000 | 36,800 | 51,600 | 34,300 | 46,500 | 33,800 | 32,500 | 29,400 | 12,700 | 7,300 |
| No. 16. Experimental (Formica); same as No. 12 in Table I; base: Pyrolized HG-81; resin: Bakelite Heat Resistant Phenolic (35%); cure: 120°-160°-175° C. Orig. F. S.: 55,500 p.s.i. | 4 | 61,900 | 47,800 | 59,900 | 46,000 | 55,300 | 46,500 | 58,000 | 42,900 | 40,100 | 43,500 | 28,800 | 23,400 |
| | 8 | 60,700 | 46,900 | 52,600 | 44,700 | 49,000 | 44,300 | 46,500 | 43,800 | 39,800 | 38,000 | 22,300 | 21,400 |
| | 16 | 62,000 | 50,500 | 53,400 | 50,600 | 52,500 | 47,400 | 41,800 | 31,400 | 29,700 | 29,400 | 19,500 | 15,600 |
| | 32 | 55,100 | 44,500 | 53,000 | 44,000 | 52,900 | 39,100 | 30,600 | 29,500 | 22,200 | 17,500 | 14,100 | 10,100 |
| No. 17. Experimental (Formica); base: Pyrolized HG-81; resin: Bakelite Heat-Resistant Modified Phenolic (35%); cure: 120°-160°-175° C. Orig. F. S.: 74,300 p.s.i. | 4 | 76,000 | 69,000 | 81,300 | 66,600 | 86,000 | 63,000 | 85,600 | 54,900 | 79,000 | 46,900 | 64,500 | 32,000 |
| | 8 | 83,000 | 72,000 | 82,600 | 61,800 | 78,000 | 67,400 | 82,200 | 57,600 | 69,200 | 38,400 | 40,500 | 39,500 |
| | 16 | 82,400 | 69,500 | 80,100 | 71,000 | 87,000 | 65,800 | 82,000 | 78,100 | 81,200 | 55,500 | 23,000 | 24,200 |
| | 32 | 85,000 | 72,400 | 84,000 | 72,400 | 81,300 | 71,900 | 77,700 | 62,000 | 35,400 | 24,700 | 10,400 | 9,000 |
| No. 18. Experimental (Formica); base: Pyrolized HG-81; resin: Reichhold General Purpose Phenolic (35%); cure: 120°-160°-175° C. Orig. F. S.: 43,700 p.s.i. | 4 | 46,200 | 42,200 | 44,300 | 37,800 | 46,300 | 37,900 | 40,300 | 36,100 | 32,400 | 31,000 | 23,600 | 23,200 |
| | 8 | 40,000 | 38,000 | 45,800 | 32,800 | 41,400 | 33,800 | 33,400 | 28,800 | 24,800 | 20,200 | 15,300 | 13,400 |
| | 16 | 40,900 | 36,500 | 42,500 | 34,200 | 40,900 | 34,500 | 30,400 | 29,600 | 23,100 | 18,200 | 16,200 | 12,000 |
| | 32 | 42,500 | 38,900 | 39,600 | 33,000 | 30,000 | 24,800 | 18,150 | 13,300 | 13,950 | 8,400 | 9,080 | 6,500 |

[a] All tests are averages of two specimens. Column headed "Room" shows values of flexural strength measured at 25° C.; column headed "Exposure" shows values when tested at "Exposure" temperature.

may be one which is not as widely exploited as may be justified.

Figure 4, p. 146, shows the time-temperature-strength surface for grade XX. It is easy to see at a glance the nature of the material. The rise in hot flexural strength with heating is easily noticeable.

With this background in mind, it is a simple matter to study the behavior of other laminates by glancing at the other sections of Table I. These have not been presented in three-dimensional charts but the main points along the route can be easily spotted by proceeding along any row at constant temperature or along any column at constant time of exposure.

Grade C canvas-phenolic laminate shows serious weight loss after two days at 200° C.; this is accompanied by serious loss of cold flexural strength even at one day. Both weight loss and cold flexural stand up reasonably well after three days at 150° C. A glance at cold flexural after one day exposure shows this property to be deteriorating steadily, even at 125° C. Thus, grade C must be rated as much poorer than grade XX, but even here the user may estimate his own risk.

Grade N-1 nylon-phenolic laminate is seen to be quite heat resistant in regard to weight loss. Above 150° C. some loss of cold flexural must be expected, but this loss may be tolerable. Because of the nylon base, hot flexural strength is seen to be low throughout. These laminates are ordinarily baked at 140° C. for 40 hr. as a standard "heat treatment" in order to stabilize dimensions. Thus, the characteristic improvement in hot flexural with exposure is absent; presumably, this material has already received a "full cure" as produced.

Grade G-5 glass-melamine laminate is seen to lose very little weight even at 250° C. Its cold flexural strength declines rather rapidly with rising temperature and more slowly with time. Even at 125° C., the cold flexural seems to be declining slowly. In this sense, its heat resistance is low. A comparison of cold flexural with hot flexural shows the "hot" value to be almost as high in all cases. Thus, G-5 softens very little upon heating, but does deteriorate. This ability of melamine resin to resist softening places it in a class by itself among materials studied in this laboratory. It undoubtedly explains why melamine materials are virtually impossible to postform.

Grade G-7 typifies many glass-silicone laminates. Its heat resistance, as judged by weight loss and cold flexural strength, is very high; its cold flexural strength is virtually unchanged at any temperature up to 250° C. in times up to three days. Its hot flexural strength is well below the cold flexural; that is, it softens upon heating. At 225 to 250° C., the hot flexural improves with exposure, rising from about 11,500 p.s.i. to about 15,000 p.s.i.

Grade AA asbestos-phenolic laminate loses relatively little weight, although this is seen to increase with increasing time and temperature. The cold flexural also declines steadily with temperature above 150° C. and slowly with time. The

(*To page* 152)

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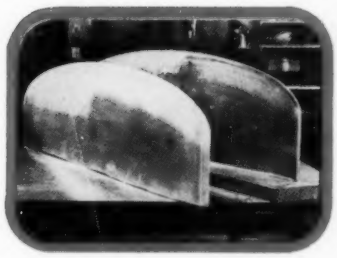

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resin is apparently decomposing. The hot flexural compares favorably with cold flexural, indicating that little softening occurs.

Grade G-1 glass-fabric phenolic laminate is seen to maintain cold flexural quite well up to 200° C. and reasonably well above 200° C., at least for short periods. Hot flexural again increases with exposure. The very high loss of weight, even at 125° C., does not seem to dictate a corresponding loss in strength. Thus, mere loss of weight may not serve for comparison of two entirely different laminates.

Laminate No. 8, made with glass fabric and an epoxy resin, is noteworthy. Weight loss is relatively small up to 200° C. Cold flexural strength seems to suffer very little even after three days at 250° C. Hot flexural is seen to be extremely low at all temperatures. This resin is exactly opposite to melamine; epoxy does not decompose, but softens badly; melamine does not soften, but decomposes readily.

Laminate No. 9 was made with glass fabric and diallyl phthalate, which is a component of many polyesters. This resin shows excessive weight loss at 200° C. and rapid decomposition at 225° and 250° C. It is similar to the epoxy as to softening.

Laminates 10 through 13 were made with glass fabrics and four commercially available heat-resistant phenolic resins. All four of these seem to be approximately equivalent; therefore, No. 12 will be considered as representative of the group. From the short-time study, this resin is seen to lose very little weight up to 225° C.; at 250° C. decomposition is evident, although not severe even after three days. The cold flexural strength follows the weight loss pattern very well; only after three days at 250° C. is the flexural strength severely lowered, which corresponds to the maximum weight-loss point. The hot flexural strength is about 80% of the cold value throughout, a satisfactory evidence of non-softening. Thus, on a short-time basis, this resin appears to be adaptable to high-temperature operation.

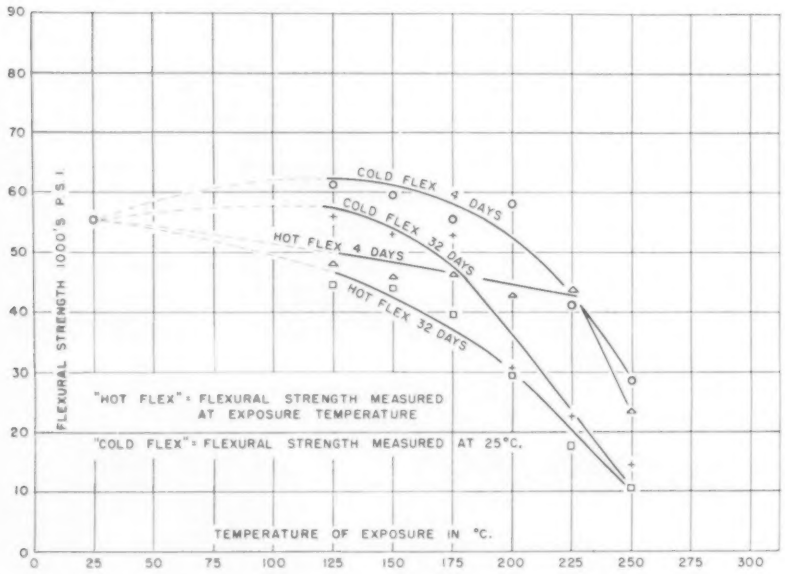
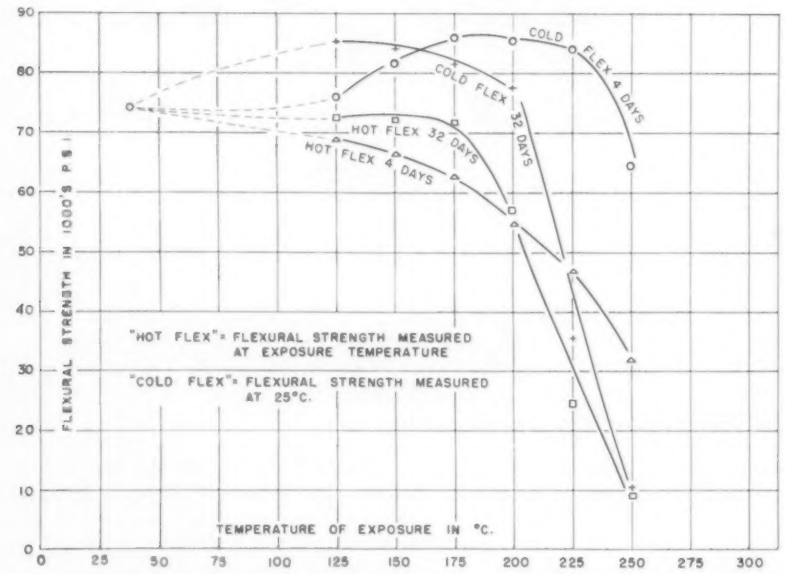

FLEXURAL STRENGTH 1000'S P S I
COLD FLEX 4 DAYS
COLD FLEX 32 DAYS
HOT FLEX 4 DAYS
HOT FLEX 32 DAYS
"HOT FLEX" = FLEXURAL STRENGTH MEASURED AT EXPOSURE TEMPERATURE
"COLD FLEX" = FLEXURAL STRENGTH MEASURED AT 25°C.
TEMPERATURE OF EXPOSURE IN °C.
0 10 20 30 40 50 60 70 80 90
0 25 50 75 100 125 150 175 200 225 250 275 300

Fig. 7—Flexural strength versus temperature for phenolic-glass laminate No. 16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COLD FLEX 4 DAYS
COLD FLEX 32 DAYS
HOT FLEX 32 DAYS
HOT FLEX 4 DAYS
"HOT FLEX" = FLEXURAL STRENGTH MEASURED AT EXPOSURE TEMPERATURE
"COLD FLEX" = FLEXURAL STRENGTH MEASURED AT 25°C.
TEMPERATURE OF EXPOSURE IN °C.
0 10 20 30 40 50 60 70 80 90
0 25 50 75 100 125 150 175 200 225 250 275 300

Fig. 8—Flexural strength versus temperature for phenolic-glass laminate No. 17

## Long-Time Exposure

Table II, p. 146, shows weight loss characteristics for a silicone laminate (No. 14), three heat-resistant phenolic laminates (No's. 15, 16, 17) and a laminate (No. 18) made with a general-purpose standard phenolic resin. All laminates were made with pyrolized HG-81 glass fabric. Examination of the lower right hand corner of the tables shows that decomposition is occurring in the area of 225 to 250° C., at times from 4 to 32 days. The number of relatively high values in this corner of the table is an index of time-temperature degradation. Note that No. 18 has many high values, as does No. 17. No.'s 15 and 16 are not free of degradation but the scarcity of excessive values shows a better resistance to heat than No's. 17 and 18. Even the silicone shows relatively high values of weight loss after 8, 16, and 32 days at 250° C. Since this does not correspond to excessive cold flexural deterioration in Table III, p. 149, it may be assumed that this weight loss merely indicates the escape of difficultly volatile matter and not resin decomposition.

Table III, p. 149, shows hot and

# The *Answer* to Faster Injection Times...

## The 'DOWDING' Patent Heating and Injection Cylinder

The short injection stroke of the Injection Plunger—operating upon homogeneously plasticized material at the nozzle end of the Heating Cylinder—produces a direct displacement of material and does not have to transmit pressure through layers of granular and semi-plasticized material.

The special 'finned' design of Heating Cylinder gives homogeneous plasticizing at high rates and is 'pre-filled' during the molding closing stroke.

**Fig. 1.—FORWARD POSITION.** Here the prefilling ring has drawn back clear of the feed and a fresh charge of material passes into the cylinder; the plunger remains forward.

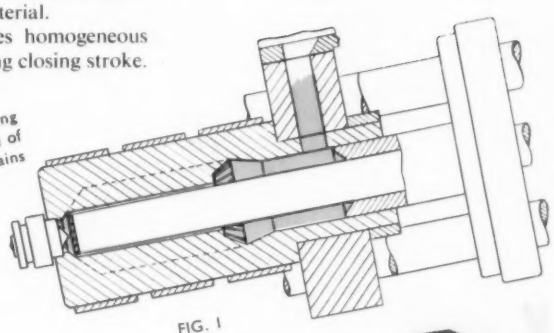

FIG. 1

**Fig. 2.—BACK POSITION.** After the new charge has been drawn in, the prefilling ring travels forward, compressing the material at the same time as the plunger moves back ready for its forward injection stroke. The nozzle is designed to restrict the escape of material during this action.

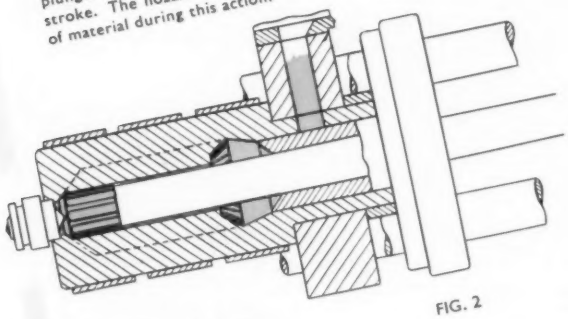

FIG. 2

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**CUTS MOLDING TIMES AND COSTS**

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*RAPID DELIVERY*

## *Fully Automatic Fast-Cycling*

# INJECTION MOLDING MACHINE

Sole Distributors for U.S.A.
Ralph B. Symons Assoc. Inc.
3571 Main Road, Tiverton, R.I.

### SPECIFICATION

| | |
|---|---|
| **Approximate weight of material plasticized per hour** (Dependent upon weight per shot and material used) | 22 lb. |
| *Area of Injection plunger* | 2.074 sq. in. |
| *Pressure per square inch on material at end of plunger* | 9,100 lb. |
| *Total pressure on Injection plunger* | 18,850 lb. |
| *Mold opens (adjustable)* | 6—9 in. |
| *Maximum die space* | 7½ in. |
| *Minimum die space* | 3½ in. |
| *Maximum recommended casting area in mold* | 15 sq. in. |
| *Size of die plates* | 16 x 10 in. |

**DOWDING & DOLL LTD**

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**Cables: ACCURATOOL HAMMER LONDON**

76A

**Table IV—Perpendicular Dielectric Strength of Some Laminates After Exposure to High Temperatures[a]**

| Resin Type | Manufacturer | Short Time Perpendicular Dielectric Strength After 1 Week at Temperature Shown, Tested in Air, Volts per Mil | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 25° C. | 125° C. | 150° C. | 175° C. | 200° C. | 225° C. | 250° C. |
| Phenolic | A-1 | 740 | 736 | 628 | 608 | 272 | 194 | 129 |
| | A-2 | 820 | 191 | 127 | 153 | 153 | 127 | 178 |
| | A-3 | 504 | 590 | 610 | 558 | 516 | 189 | 141 |
| | B-1 | 555 | 354 | — | 243 | — | 114 | — |
| | B-2 | 397 | 354 | — | 286 | — | 143 | — |
| | C-1 | 622 | 618 | — | 564 | — | 297 | 197 |
| | C-2 | 496 | 285 | 353 | 105 | 157 | 124 | 112 |
| | C-3 | 800 | 745 | 755 | 720 | 720 | 665 | 514 |
| | C-4 | 247 | 85 | — | 83 | — | 141 | 141 |
| | C-5 | 783 | 633+ | 635+ | 594 | 602 | 614 | 391 |
| Epoxy | D-1 | 1090 | 600+ | 600+ | 600+ | 600+ | 600+ | 600+ |
| Diallyl Phthalate | E-1 | 1230 | 628+ | 659+ | 630+ | — | 148 | 101 |

[a] All resins were placed on pyrolized HG-81 fabric, with a 40% pick-up, and press cured for 20 min. at 175° C. (except B-2 which was on asbestos mat). Dielectric strength was measured in air using 2-in. electrodes. All resins with same code letter (A, B, C, etc.) were from same manufacturer; number 1, 2, etc. identifies different samples from same manufacturer.

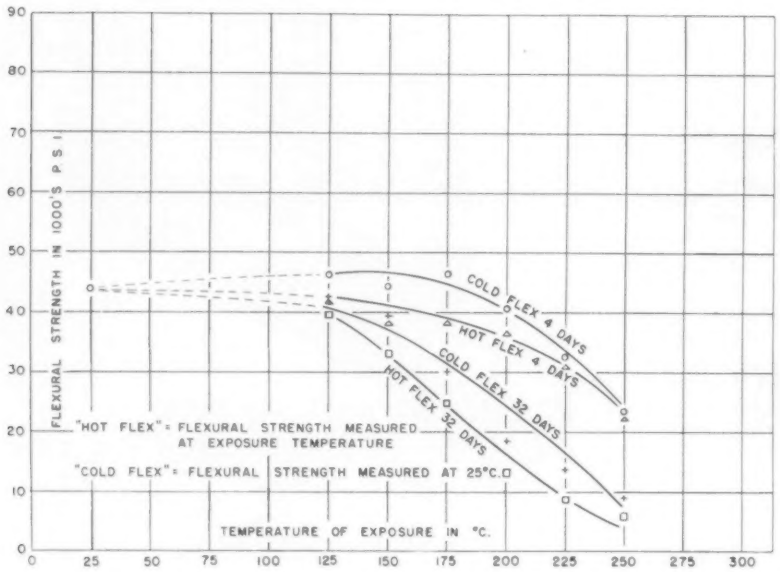

FLEXURAL STRENGTH IN 1000'S P.S.I.
TEMPERATURE OF EXPOSURE IN °C.
COLD FLEX 4 DAYS
HOT FLEX 4 DAYS
COLD FLEX 32 DAYS
HOT FLEX 32 DAYS
"HOT FLEX" = FLEXURAL STRENGTH MEASURED AT EXPOSURE TEMPERATURE
"COLD FLEX" = FLEXURAL STRENGTH MEASURED AT 25°C.

Fig. 9—Flexural strength versus temperature for phenolic-glass laminate No. 18

cold flexural strengths on these same materials. Part of these data are shown graphically in Figs. 5 through 9, pp. 148 and 152. Again, by following the rows and columns, the trend of the property for various temperatures with constant time of exposure, or for various times with a constant temperature can be discovered. For instance, the cold flexural strength of laminate No. 16 is 46,500 p.s.i. after 8 days at 200° C.; the original "as pressed" value was 55,500 p.s.i. Does this represent degradation or not? By scanning the 200° C. column showing cold flexural strength versus time, it is seen that the flexural strength decreases as follows: 58,000; 46,500; 41,800; 30,600 p.s.i. Thus, there is evidence of degradation at 200° C. with time. Meanwhile, the cold flexural strength of 8 days exposure is shown in the second row with increasing temperatures. These values are 60,700; 52,600; 49,000; 46,500; 39,800; 22,300 p.s.i. The trend is very clear; the flexural strength is declining with rising temperature. Thus, both time and temperature trends indicate degradation and the value of 46,500 p.s.i. must be considered as a value that shows true degradation from the initial observation of 55,500 p.s.i.

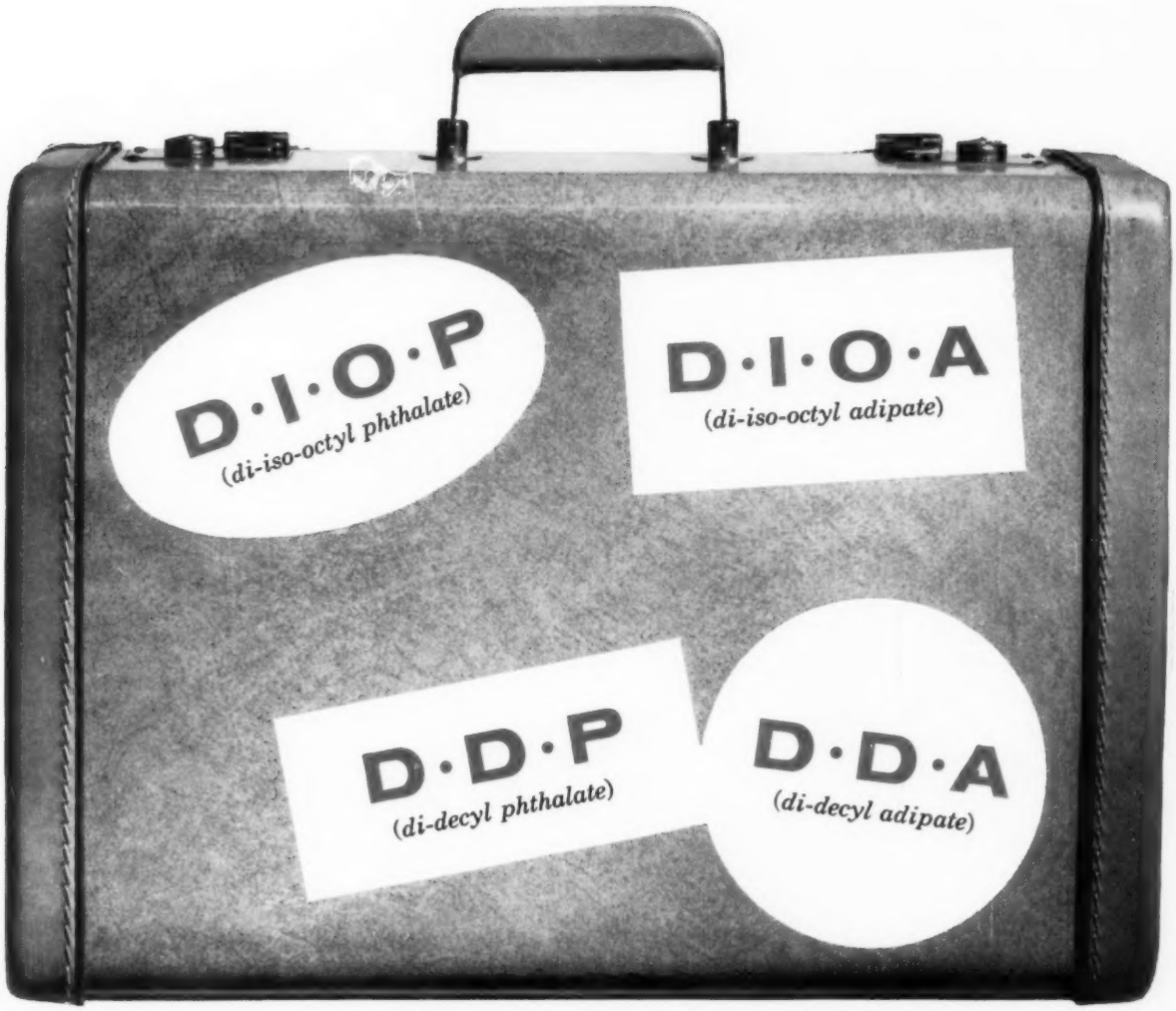
In order to facilitate the visualization of the behavior of this resin, Fig. 10, p. 242, has been prepared. Here the area of possible operation is completely shown; intermediate points which do not appear in the tabulated data can be readily visualized. Apparently, operation for long periods up to 175° C. can be tolerated. Such operation takes place at the boundary of a relatively level plane which stretches backward toward lower temperature levels. At temperatures higher than 175° C. the plane drops into a valley that deepens rapidly as 250° C. is approached. Obviously, long time operation at 225° C., for instance, is not good practice; nevertheless, for a given operation, the risk can be estimated. For instance, after 16 days at 225° C. the flexural strength is still 29,700 p.s.i. This is over 50% of the original. Degradation has occurred but the laminate may still function satisfactorily. Also, knowledge of the short-time high-temperature area is gained. For instance, after one day at 250° C. the flexural strength is still 49,500 p.s.i. (Points obtained from Table I, No. 12; same material as Table II, No. 16.) After 4 days at 250° C. the cold flexural is 28,800 p.s.i., which may still be useful. It is interesting to note the hump in the plane in the vicinity of one to two days and 100 to 150° C. This is the familiar increase in flexural strength due to additional cure of the resin.

Figure 11, p. 242, shows the hot flexural strength characteristics of a silicone laminate in three dimensions. This laminate is further described in Table II, laminate No. 14 and in Fig. 5. The loss in cold flexural strength is considered abnormal for silicones, although the softening tendency with rising temperature is typical.

## Dielectric Strength

Following the above tests, the resin used in laminate No. 16 was chosen as being a highly heat-resistant phenolic and its use in thin sheets requiring long-time exposure to high temperature was proposed. The sheets were required to be $\frac{1}{32}$

(To page 240)

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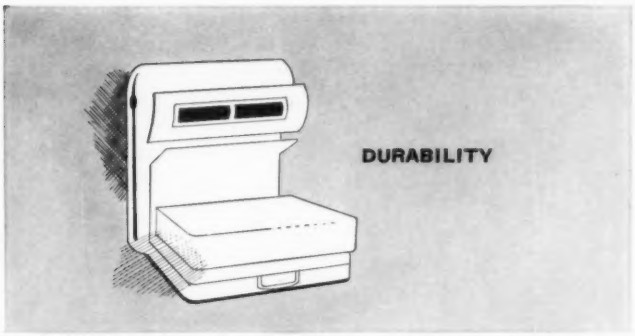


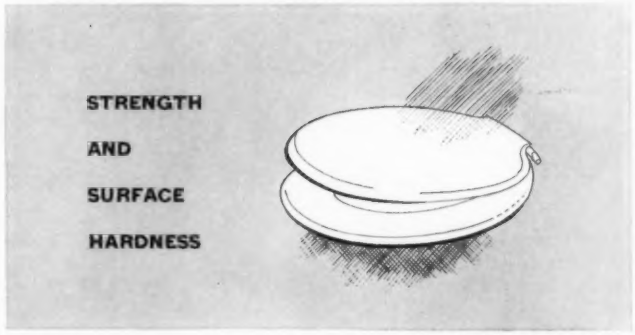


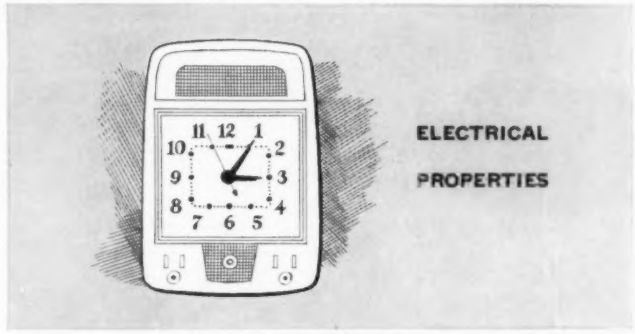


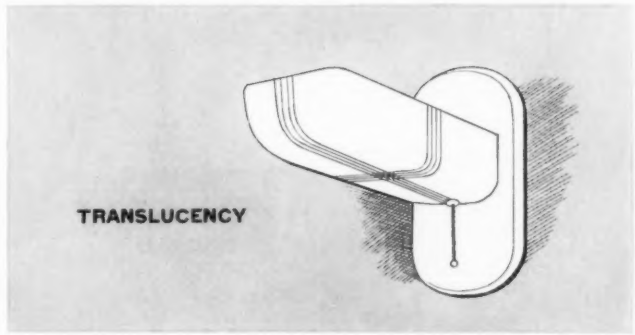

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# Water Tolerance Values of VINYL PLASTICIZERS

by PHILIP C. DAIDONE*

**The order of solvent power of hydrophobic plasticizers with acetone as a reference solvent can be expressed conveniently and precisely by reference to specific water values for equal weight comparison or to molar water value for molecular weight comparison. It is further suggested that this same order persists when considered as solvents for macromolecules. The experience of other workers is cited to show this relationship.**

A PRIMARY factor of importance in plasticizers is solvent power. In fact, the classification of most plasticizers is made on the basis of this factor. At present there is no simple analytical value available to the plastics formulator that characterizes plasticizers in some relative order. Present methods of plasticizer characterization consist of a study of physical properties of plastic compounds (1, 2, 3)[1] amounting to full evaluation of all important factors.

It is the purpose of this paper to suggest a method of characterizing hydrophobic plasticizers by assigning to each an empirically determined value which is, in effect, a measurement of the relative solubility of the plasticizer in acetone. Having established such a system of values, there will be indicated a relationship of these values to plasticizer/resin compatibility.

## Water Values of Plasticizers

When a plasticizer is dissolved in acetone, a solution results which may be titrated with water to a phase separation that is sharp and easily duplicated. The titration, which is called the observed water value, will vary with the size of sample and volume of acetone. The variation of observed water value with weight of sample was determined for five plasticizers to show the permanency of relative order as well as to indicate a convenient weight for making comparisons. Figure 1 illustrates such a comparison.

In making subsequent titrations on different plasticizers, a sample weight of 2.5 grams in 25.0 ml. of acetone was used. In order to increase the sensitivity of the titration, one could dissolve any sample weight in the proper volume of acetone; for example, 25.0 ml. of acetone for 2.5 grams of plasticizer; 100 ml. of acetone for 10.0 grams of plasticizer; 50.1 ml. of acetone for 5.01 grams of plasticizer. It is apparent that, having the accurate weight of sample, the correct amount of acetone could be added by means of a burette. All titrations were performed at 26° ± 1° C. using distilled water.

The observed water value was then easily transformed into the specific water value by dividing by the weight of sample taken. Multiplying the specific water value by the molecular weight of the plasticizer resulted in the molar water value.

A comparison of water values of different plasticizers is presented in Table I, p. 160.

When absolute methanol is substituted for acetone, different specific water values result but with retention of relative order. Table II, p. 162, depicts a comparison for a few plasticizers. It might be stated here that the sharpness of the end point was more gradual with methanol and thus acetone is by far the better solvent to use. With the exception of Table II, all the water values reported in this paper are for the acetone system.

Figures 2 and 3 represent the variation of specific water values with changes in composition of common binary plasticizer systems.

Contributions to specific water value may be made by polar groups which may be distinguished by the names hydrophilic and hydrophobic. Hydrophilic groups, which have been excluded from this study, include the hydroxyl, amino, sulfonic, and carboxyl groups. They would increase the specific water value, but would not be good solvating groups. The water value increase in these cases would be due to association by hydrogen bonding.

Hydrophobic groups such as organic halides and esters evidently

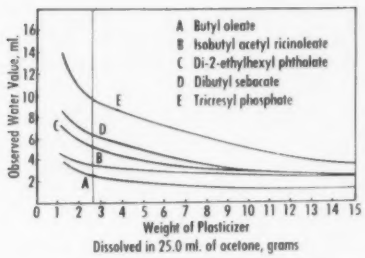


Fig. 1—Variation of observed water value with weight of sample

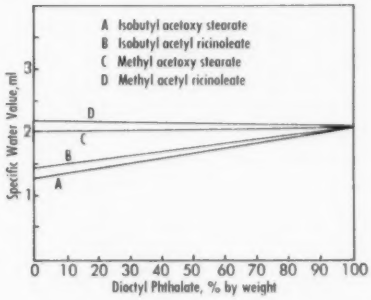
A Isobutyl acetoxy stearate
B Isobutyl acetyl ricinoleate
C Methyl acetoxy stearate
D Methyl acetyl ricinoleate
Specific Water Value, ml
Dioctyl Phthalate, % by weight

Fig. 2—Variation of specific water value with composition of binary mixtures containing dioctyl phthalate

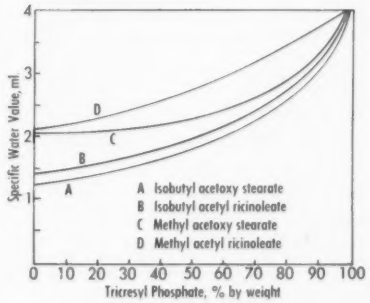
A Isobutyl acetoxy stearate
B Isobutyl acetyl ricinoleate
C Methyl acetoxy stearate
D Methyl acetyl ricinoleate
Specific Water Value, ml
Tricresyl Phosphate, % by weight

Fig. 3—Variation of specific water value with composition of binary mixture containing tricresyl phosphate

* The Baker Castor Oil Co.

[1] Numbers in parentheses link to references at end of article, p. 162.

are so soluble in acetone (due to solvation) that their insolubilization requires more water. This is the essential point to be understood in a consideration of specific water values as a system of classification.

Ethers and ethylene groupings have been included in this study because of their common occurrence in commercial plasticizers. These groups are essentially non-polar and their contribution to specific water value is believed to be the result of their weakly hydrophilic nature when an induced dipole is formed. Their contributions to solvency, therefore, are expected to be low.

Without going into a discussion of polarity and the interrelation between dipole moments and chemical structure, suffice it to say that systems with water as one component have been known to throw light upon the effects of polarity as it relates to solubility (4).

Figure 4, p. 162, gives a comparison of film clarity of vinyl chloride-acetate plastisol cast films using 15 different plasticizers in identical formulas which were fused under the same conditions of time and temperature. It shows a suggested correlation between specific water values and solvency. As one ascends a homologous series of esters, the specific water value decreases. One would expect the solvent power, therefore, to decrease in like manner. It has been noted by various authors (1, 2) that the efficiency of a homologous series of plasticizers does, indeed, diminish as the molecular weight increases.

Lawrence and McIntyre (1) have also observed that the water extractibility in a homologous series decreased with increase in molecular weight. The extractibility of phosphates was greater than sebacates which exceeded the phthalates. Their observations would have been predictable, qualitatively, from the relative magnitude of the specific water values of those plasticizers. It is suggestive to say that water extractibility is qualitatively predictable from specific water values.

Upon studying Table I, certain trends are noticeable. The acids that tend to give higher specific water values are those which in the free state are the stronger acids. For example, phosphoric acid is rather highly ionizable, while the organic acids are less so. It would seem,

**Table I—Water Values of Plasticizers**

| Chemical name of plasticizer | Tradename | Molecular weight | Water values | | |
|---|---|---|---|---|---|
| | | | Observed | Specific | Molar |
| Triphenyl phosphate | — | 310 | 8.85 | 3.54 | 1097 |
| Tricresyl phosphate | Celluflex 179C | 368 | 9.90 | 3.96 | 1458 |
| Alkylaryl phosphate | Santicizer 141 | 362 | 10.25 | 4.10 | 1484 |
| Tri-2-ethylhexyl phosphate | Flexol TOF | 435 | 5.95 | 2.38 | 1032 |
| Tributoxyethyl phosphate | KP-140 | 398 | 21.95 | 8.78 | 3490 |
| Dibutyl phthalate | — | 278 | 10.00 | 4.00 | 1112 |
| Butyl benzyl phthalate | Santicizer 160 | 312 | 10.05 | 4.02 | 1254 |
| Butyl decyl phthalate | PX 114 | 362 | 5.50 | 2.20 | 796 |
| Diheptyl phthalate | — | 362 | 5.70 | 2.28 | 825 |
| Di-2-ethylhexyl phthalate | — | 390 | 5.15 | 2.06 | 803 |
| Di-2-ethylhexyl hexahydrophthalate | Flexol CC-55 | 396 | 4.40 | 1.76 | 697 |
| Dicapryl phthalate | Harflex 180 | 390 | 5.50 | 2.20 | 858 |
| Diisooctyl phthalate | PX 108 | 390 | 5.20 | 2.08 | 812 |
| Diisodecyl phthalate | — | 446 | 4.15 | 1.66 | 740 |
| Methyl ricinoleate | Flexricin P-1 | 310 | 8.70 | 3.48 | 1079 |
| Methyl acetyl ricinoleate | Flexricin P-4 | 352 | 5.50 | 2.20 | 774 |
| Butyl acetyl ricinoleate | Flexricin P-6 | 394 | 3.50 | 1.40 | 552 |
| Isobutyl acetyl ricinoleate | Flexricin 66 | 394 | 3.60 | 1.44 | 567 |
| Glyceryl tri (acetyl ricinoleate) | Flexricin P-8 | 1052 | 2.50 | 1.00 | 1052 |
| Methyl Cellosolve acetyl ricinoleate | Flexricin P-4C | 398 | 6.75 | 2.70 | 1074 |
| Benzyl acetyl ricinoleate | — | 428 | 3.45 | 1.38 | 591 |
| Methyl acetoxy stearate | Paricin 4 | 354 | 5.10 | 2.04 | 722 |
| Butyl acetoxy stearate | Paricin 6 | 396 | 3.15 | 1.26 | 500 |
| Isobutyl acetoxy stearate | Paricin 66 | 396 | 3.30 | 1.32 | 523 |
| Glyceryl tri (acetoxy stearate) | Paricin 8 | 1058 | 1.85 | 0.74 | 782 |
| Methyl Cellosolve acetoxy stearate | Paricin 4C | 400 | 6.00 | 2.40 | 960 |
| Butyl stearate | — | 340 | 1.95 | 0.78 | 265 |
| Butyl oleate | — | 338 | 2.60 | 1.04 | 351 |
| Phenoxyethyl oleate | Pycal 70 | 402 | 3.70 | 1.48 | 595 |
| Tetrahydrofurfuryl oleate | PX 658 | 366 | 4.70 | 1.88 | 688 |
| Isooctyl palmitate | RC plasticizer 0-16 | 348 | 1.35 | 0.54 | 188 |
| Butyl undecylenate | — | 238 | 4.90 | 1.96 | 466 |
| Methyl undecylenate | — | 196 | 8.00 | 3.20 | 627 |
| Methyl-11-acetoxy-9-undecenoate | — | 258 | 12.95 | 5.18 | 1336 |
| Methyl-11-acetoxy-undecanoate | — | 256 | 13.00 | 5.20 | 1330 |
| Glyceryl triheptanoate | — | 428 | 5.15 | 2.06 | 881 |
| Dibutyl sebacate | Harflex 40 | 240 | 6.45 | 2.58 | 619 |
| Diisooctyl sebacate | PX-408 | 426 | 3.40 | 1.36 | 580 |
| Butyl benzyl sebacate | Harflex 45 | 346 | 6.70 | 2.68 | 927 |
| Diisooctyl azelate | Plastolein 9057 | 412 | 3.70 | 1.48 | 610 |
| Di-2-ethylbutyl azelate | Plastolein 9050 DHZ | 356 | 5.20 | 2.08 | 740 |
| Diisooctyl adipate | PX-208 | 370 | 4.75 | 1.90 | 703 |
| Diethylene glycol dipelargonate | Plastolein 9055 DGP | 386 | 6.00 | 2.40 | 926 |
| Triethylene glycol dicaprylate | RC plasticizer TG-8 | 402 | 7.60 | 3.04 | 1220 |
| Polyethylene glycol di-2-ethylhexoate | Flexol 4 GO | — | 9.50 | 3.80 | — |
| Chlorinated paraffin (40%) | Chlorowax 40 | — | 2.65 | 1.06 | — |
| Methyl pentachlorostearate | MPS-500 | 470 | 4.85 | 1.94 | 913 |
| Epoxy plasticizer | Paraplex G-60 | — | 2.70 | 1.08 | — |
| Epoxy plasticizer | PX-800 | — | 2.80 | 1.12 | — |
| Epoxy plasticizer | Admex 710 | — | 2.97 | 1.18 | — |
| Partially hydrogenated terphenyl | HB-40 | — | 3.47 | 1.38 | — |

# PARAPLEX P-43

## in KOCH *Fiberglas Luggage*

Fiberglas luxury luggage, styled and molded by H. Koch & Sons, San Francisco, California.

Koch of California chose PARAPLEX P-43 polyester resin not only for the handsome luggage shown above, but also for special camera cases for the United States Air Force Here are some of the properties which influenced Koch in their selection of PARAPLEX P-43:

**Excellent strength—weight ratio.** PARAPLEX P-43 demonstrates its great strength under severe tests, allowing Koch to advertise "lighter than leather, stronger than steel."

**Resists scuffing and staining.** PARAPLEX P-43 provides a durable surface that cannot be harmed by rough treatment in baggage cars and aircraft luggage compartments. It is the first truly "Worry-Free" luggage.

**Outstanding color stability.** PARAPLEX P-43 permits the use of a wide range of attractive colors.

**Easy production.** PARAPLEX P-43 is not sensitive to fluctuations in molding temperatures, can be used in all types of molding equipment. Even in resin-rich areas, PARAPLEX P-43 is highly resistant to cracking and crazing. And PARAPLEX P-43 reduces inventory problems by virtue of its long shelf life.

Where high impact strength and toughness are desired, PARAPLEX P-43 rigid polyester can be blended with the flexible PARAPLEX P-13 to give the required strengths. The PARAPLEX P-Series resins can be catalyzed for room temperature or elevated temperature cure.

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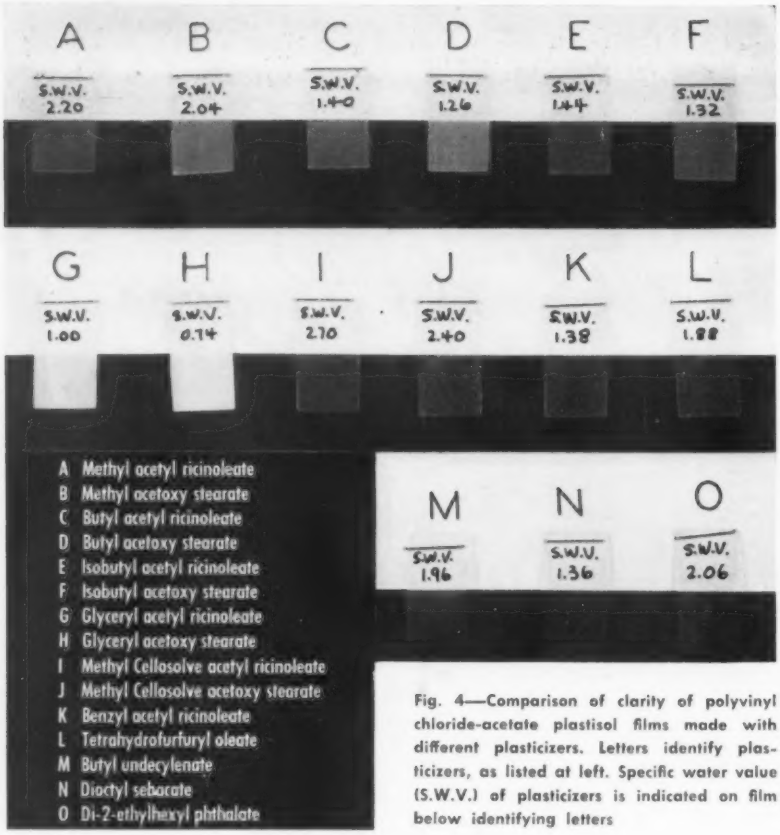


Fig. 4—Comparison of clarity of polyvinyl chloride-acetate plastisol films made with different plasticizers. Letters identify plasticizers, as listed at left. Specific water value (S.W.V.) of plasticizers is indicated on film below identifying letters

therefore, that dialcohol phosphate esters should prove to be a type of plasticizer to be desired from the viewpoint of solvency and low temperature flexibility.

From the viewpoint of balance, the series of diesters represented by the various acetyl ricinoleates and acetoxystearates is rather suitable. The former, however, are subject to exudation (double bond effect) on aging, while the acetoxystearates are more permanent. The formulator may well take advantage of the combined solvency and low temperature properties of those products. Their specific water values are relatively high, indicative of a good order of solvency. These products, of course, are about 90% pure with the remaining 10% being straight chain esters, which probably accounts for the slight clouding when used alone. It is, therefore, suggested that these plasticizers be upgraded with stronger solvating plasticizers.

The contribution of ether groups to solvency has been reported to be small (1). The presence of those groups in plasticizers tends to give increased specific water values, due to their hydrophilic nature and not due to dipole effects. Having gone into the hydrophilic nature of both ether groups and double bonds, the author would like to state that the reasons for some plasticizer exudation may be due to the presence of hydrophilic groups which are capable of orientation at the film—moist air interface. It has been mentioned (1) that ether groups have a tendency to increase migration and water sensitivity.

The effect of chlorination on specific water values is interesting.

**Table II—Comparison of the Effect of Solvent on the Specific Water Value**

| | Specific Water Values | |
|---|---|---|
| Plasticizer | Acetone | Absolute methanol |
| Methyl acetyl ricinoleate | 2.20 | 0.64 |
| Methyl acetoxy stearate | 2.04 | 0.42 |
| Butyl acetyl ricinoleate | 1.40 | 0.20 |
| Butyl acetoxy stearate | 1.26 | 0.08 |
| Isobutyl acetyl ricinoleate | 1.44 | 0.22 |
| Isobutyl acetoxy stearate | 1.32 | 0.16 |
| Glyceryl tri (acetyl ricinoleate) | 1.00 | 0.00 |

Paraffins are known to be incompatible with vinyl chloride type resins. However, chlorination to the extent of 40% chlorine results in a compatible plasticizer which must be used jointly with a solvent plasticizer to help retention. The specific water value agrees very well with this observation. A specific water value of 1.06 indicates a compatible range of solvency of a lower order. Methyl pentachlorostearate, likewise, having a specific water value of 1.94, has been found compatible with vinyl chloride type resins.

Functional group contributions to solvency and specific water values depend upon the spatial configuration of solvating groups. For example, the ester groups in dibutyl phthalate are apparently stronger solvating groups than those in dibutyl sebacate. The closeness of the former makes them not capable of "cross-solvation" to the extent of dibutyl sebacate. The idea of "cross-solvation" is introduced here as a possible explanation for the superior low-temperature properties of long chain dibasic acid esters. It is believed that the ability to keep macromolecules apart is greater because the linear esters are oriented in a perpendicular fashion to the polymer chain. This mechanical advantage is made all the more permanent by the strong solvating groups. The ability of dibutyl sebacate to "gel" polyvinyl chloride-acetate (Pliovic AO) more rapidly than tricresyl phosphate is readily understood from a consideration of its "cross-solvating" ability, while tricresyl phosphate because of a centrally located solvating group, is not capable of "cross-solvation." The solvent power of the phosphate ester is, however, greater when comparing equal quantities. The specific water value of tricresyl phosphate is 3.96 while that of dibutyl sebacate is 2.58.

## References

1. Robert R. Lawrence and Elizabeth B. McIntyre, Ind. Eng. Chem. *41*, 689-694 (1949).

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3. Arnold Kirkpatrick, J. Applied Physics *11*, 255-261 (1940).

4. Joel H. Hildebrand, "Solubility of Non-Electrolytes," 2nd ed. (1936), p. 149, New York: Reinhold Publishing Co.

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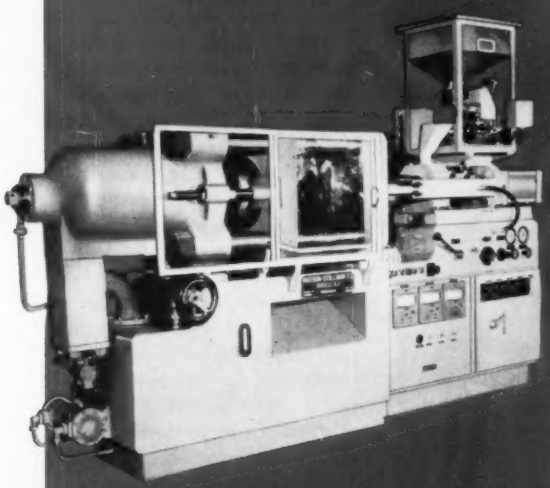

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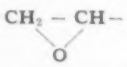
# Processing of EPOXY RESINS

by VINCENT SUSSMAN*

THE EPOXY resins are polyethers with terminal epoxide groups.



Most of the commercially available resins are reaction products of epichlorohydrin and bisphenol (Fig. 1, Equation I). The length of the polymer (a function of the value of $n$) determines the viscosity. When $n$ is 0, the viscosity is about 1000 centipoises. As $n$ increases, the viscosity increases until when $n$ is 10, the resin is a high-melting-point solid.

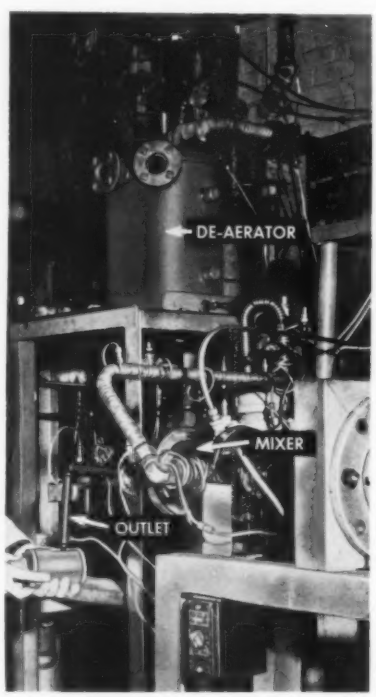
Commercial specifications of the resins usually list the viscosity and epoxide equivalent. The epoxide equivalent is the grams of resin containing one gram mole of epoxide. A low-viscosity resin has an epoxide equivalent of 150. As the polymer increases in length, the epoxide equivalent increases.

## Hardening Reaction

The epoxy resins are thermosetting and cure when combined with complex amine hardeners. Other difunctional reactants can be employed, such as dibasic carboxylic anhydrides, isocyanates, as well as polyamides.

The amine reacts by opening the epoxide group to form an alcohol. (Fig. 1, Equation II.) The polymerization reaction proceeds without the formation of by-products. The reaction is exothermic and temperatures exceeding 450° F. have been observed.

Depending on the resin and hardener employed, the reaction may proceed at room temperature or require elevated temperatures. Since the hardener enters into the reaction, the type of hardener selected will affect the properties of the cured resin.



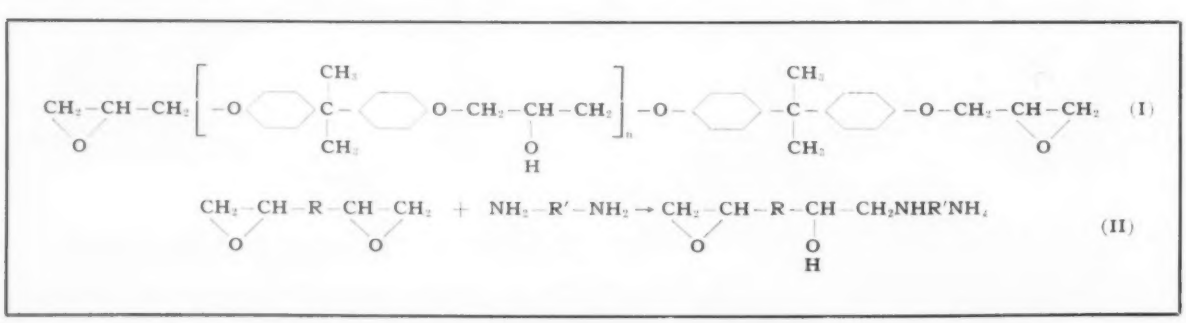

Typical equipment and set-up used in the processing of epoxy resins

## Rheological Considerations

The end application will determine the desired viscosity of the resin and hardener blend. Potting and encapsulation of electrical parts require a low viscosity to impregnate fine structures and to easily fill voids. A sealant requires that the resin stay in place and a high viscosity mixture is desired. Adhesives require varying viscosities according to the particular application. In bristle setting for the brush industry, the adhesive must penetrate up to the ferrule.

A method for controlling this penetration is by adjusting the viscosity and the rate of increase of viscosity. The viscosity of the resin mixture may be controlled by the type of resin and hardener selected. Temperature affects not only the viscosity but also the pot life.

Pot life is the time interval to reach the maximum useful viscosity for the particular application. The pot life of a resin and hardener blend is a function of the size of the batch and the shape of the container. When a batch of a resin and hardener is maintained at constant temperature, a gradual increase in viscosity is ob-



(I)



(II)

Fig. 1—Chemical reactions of epoxy resins. Equation I (top)—Epoxy resins formed as reaction product of epichlorohydrin and bisphenol. Equation II (bottom)—Hardening reaction of epoxy resin, using a complex amine hardener which opens epoxide groups to form alcohol

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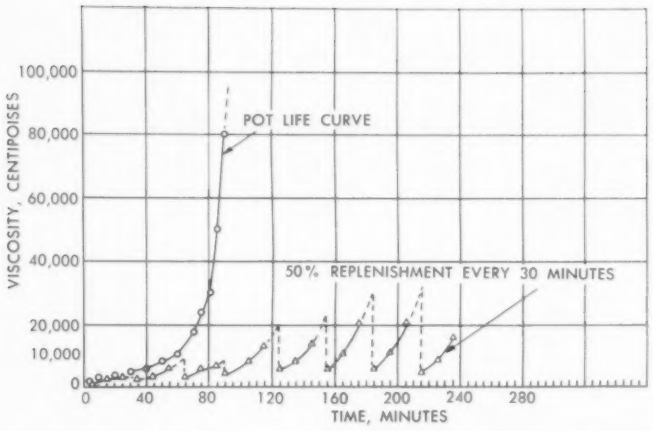


Fig. 2—Pot life and replenishment curves (Bakelite resin 18774: 100 parts; ethylenediamene hardener: 10 parts; temperature 70° F.), with 50% replenishment added at 30-min. intervals, showing fluctuations in viscosity values

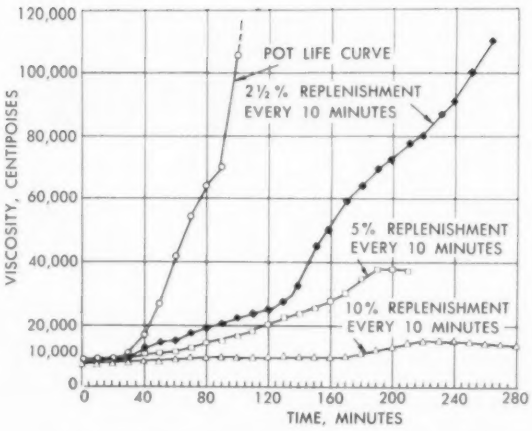


Fig. 3—Pot life and replenishment curves (Bakelite resin 18795: 100 parts; hardener 18793: 25 parts; temperature 68 ± 3° F.); smaller increments are added more frequently

served (see "pot life curve," Fig. 2). This is independent of the size and shape of the container.

## Activating the Resin

The resin and hardener may be blended batch-wise or in continuous proportioning and mixing units.

Batch mixing may be accomplished in a change can mixer. Solid and semi-solid resins are processed at temperatures above the melting point. Short pot life mixtures are not feasible for production operations by the batch method. Medium and long pot life mixtures may be employed. Small batches and low temperatures prolong the pot life. The viscosity increases with time.

Continuous systems overcome this effect. Short pot life mixtures become practical and a more uniform viscosity may be maintained. The hardener and resin are metered into the mixer by means of a bellows system which maintains the desired proportions. Mixing is accomplished by means of impellers forcing the material through a series of diffusion plates containing a large number of holes. The material is recirculated through the mixer and mixed with fresh material to extend the pot life. The mixing chamber is jacketed to maintain constant temperature. All lines and chambers are jacketed to permit the handling of solid components as well as liquids.

## De-aeration

The maximum physical and electrical properties of the cured resin are obtained by using air-free resin.

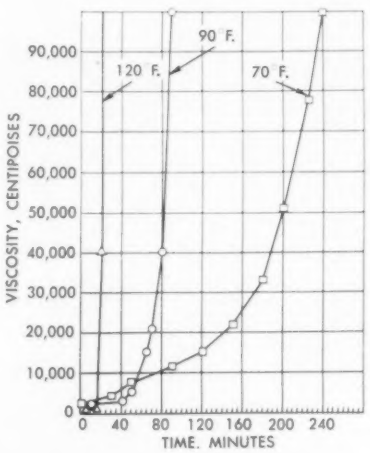


Fig. 4—Pot life curves at various temperatures (Bakelite resin 18744: 100 parts; hardener 18812: 22.5 parts)

Because of the relatively high viscosity of the resin mixtures, air is easily entrapped during batch mixing. During curing, the high exotherm causes the air bubbles to expand. This results in fracturing, foaming, and the formation of voids. With long pot life mixtures and small batches, a large proportion of the air can escape before gelation occurs and good castings are possible. However, with short pot life systems and large castings, de-aerated material is essential for a good product. Continuous systems furnish air-free resin mixtures by de-aerating the components individually and then mixing them in a filled system.

In any operation, the resin and hardener mixture is consumed over a period of time. By replenishing the consumed material with fresh resin and hardener, the pot life can be extended. A replenishment curve is plotted in Fig. 2.

By replenishing 50% of the volume every 30 min., a saw-tooth curve of increasing viscosity with sudden drops is observed. The viscosity trend increases to a maximum and then becomes constant. The aged material is consumed and diluted with fresh material until the original material becomes infinitely small.

The polymer grows as the reaction proceeds. With each replenishment, a diluting effect takes place. Also, the shorter chains are more mobile and minimize the probability of the aged material (long chains) reacting with other long chains. It has been observed in many cases that by mixing a batch of volume $V$, and replenishing at the rate of 50% of the volume in pot life time (at constant temperature), the pot life can be extended indefinitely.

Smaller increments added at a greater frequency result in a more uniform viscosity. Figure 3 demonstrates typical pot life and replenishment curves at 10-min. intervals. The 10% replenishment every 10 min. is the equivalent of 50% every 50 minutes. From the pot life curve, it is noted that at 50 min. the viscosity is 27,000 centipoises. The curve approaches this viscosity.

The 2½% replenishments every 10 min. provide 50% of fresh material every 200 minutes. From the pot life

(To page 245)

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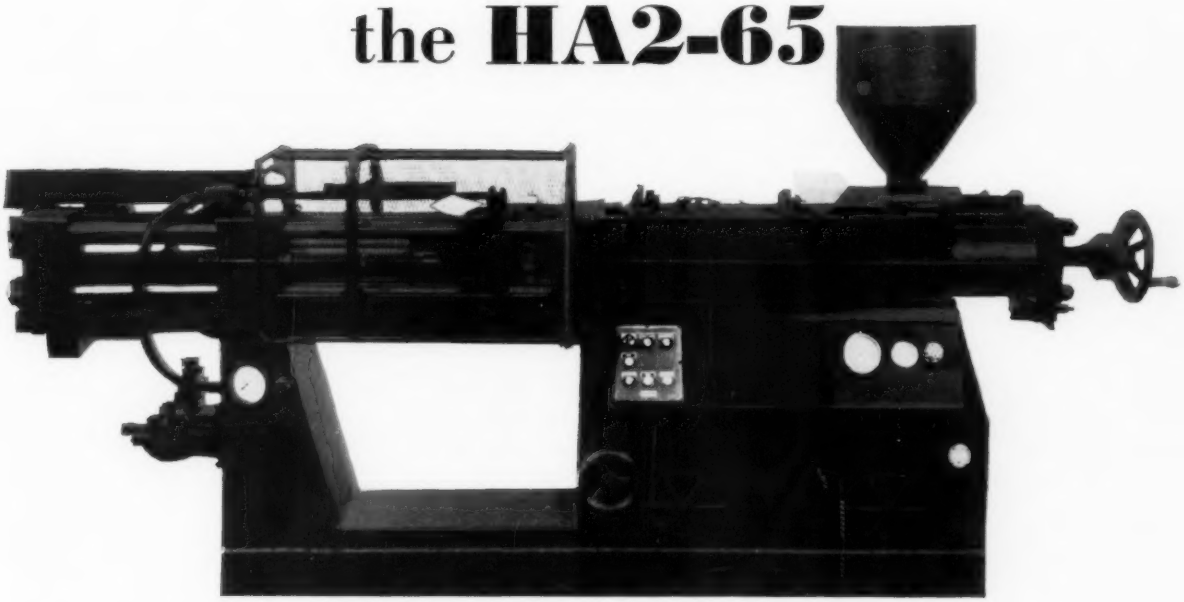

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# PLASTICS DIGEST*

**Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.**

## General

PLASTICS IN 1954. E. E. McSweeney and E. L. Kropa. Chem. Eng. News *33*, 16-19 (Jan. 3, 1955). Developments in the plastics industry in America in 1954 are reviewed. Among the developments discussed are: the increasing sales of polyethylene and various technological advances in its production; the use of radiation for polymerization and for cross-linking polymers; the pending large scale production of isocyanates and polyurethanes in this country; the increasing plant capacity for the production of phenol, phenolic compounds, and formaldehyde; the use of glass fiber-reinforced polyesters for automobile bodies; the increased production of epoxy resins; the development of fluorocarbon rubbers; the increasing interest in polyamides and the increasing use of caprolactam as an intermediate for both polyamide fiber and molding compounds; advances in the field of synthetic ion-exchange membranes; and the controversy arising from melamine dinnerware making inroads on sales of conventional china.

PLASTICS. R. B. Seymour. Ind. Eng. Chem. *46*, 2135-48 (Oct. 1954). Scientific and technical developments during the past year are reviewed. 316 references.

## Materials

FLUOROCARBON PLASTICS TODAY. H. Lee. Product Eng. *25*, 168-73 (Oct. 1954). The physical, mechanical, and electrical properties of the basic types of fluorocarbon plastics are compared and the potential usefulness of some newer types are evaluated. Both the "non-rigid" (Teflon) and the "thermoplastic rigid" (Kel-F) types are chemically inert and possess zero moisture absorption, but in the rigid type, chlorine in the fluorocarbon molecule contributes to exceptional flow, transparency, and rigidity characteristics. The two types are compared as regards fabrication techniques and cost. The mechanical, electrical, chemical, physical-chemical, and optical properties of rigid chlorotrifluoroethylene polymer are discussed in detail. Strength and stiffness increase with increasing crystallinity of the polymer. The rate of crystallization increases with decreasing molecular weight. Rapid cooling of the fabricated product produces greater flexibility by reducing crystallinity. The high molecular weight materials can withstand heat aging and subsequent flexing without embrittlement. Chlorotrifluoroethylene polymer retains some of its impact strength and toughness at temperatures as low as −320° F. It is colorless and can be made transparent or translucent to visible light as desired; it is also transparent in the infra-red. It is much superior to polyethylene as a barrier to water.

ACONITIC AND TRICARBALLYLIC ACID ESTERS AS VINYL PLASTICIZERS. E. J. Roberts, L. F. Martin, F. C. Magne, and R. R. Mod. Rubber World *130*, 801-804 (Sept. 1954). Methods are described for the preparation of triesters of aconitic acid in good yield directly from the acid or the commercially available salt, and for the hydrogenation of these esters to the corresponding tricarballylates. A method is also described for the preparation of mixed esters of tricarballylic acid and for obtaining satisfactory yields of esters of secondary alcohols of higher molecular weight. A series of esters of alcohols ranging from propyl to octyl were prepared and purified by distillation to obtain products of sufficient purity for determination of physical properties. These esters were screened for their plasticizing characteristics with polyvinyl chloride acetate copolymer and the results indicate that some may be used in place of di-2-ethylhexyl phthalate.

HARD RUBBER. H. Peters, Ind. Eng. Chem. *46*, 2112-13 (Oct. 1954). Scientific and technical developments during the past two years in the field of hard rubber are reviewed. Fundamental research is relatively inactive. Patent interest is unusually keen, and more than half the literature references deal with this subject. Development of hard rubber from latex is gaining momentum, and claims are made that it can compete economically with methods of dry mixing. 67 references.

## Molding & Fabricating

THERMAL DEGRADATION OF POLYMERS DURING MOLDING. II. EXPERIMENTAL STUDY. H. L. Frisch, V. T. Stannett, S. Dalheim, and I. Sobolev. SPE J. *10*, 31-32, 42 (Oct. 1954). An experimental study was made of the extent of polymer degradation during molding both as a function of the number of molding cycles and the cylinder temperature. The effects of this degradation on the viscosity and Izod impact strength of polystyrene are reported. The results indicate that the extent of degradation after seven moldings is 7.5% and 13.6% at 460° F. and 560° F., respectively. These results agree well with a previously proposed theory. At both temperatures the impact strength levels off at a value not very different from that of the original material, but the impact strength decreases slightly with an increase in temperature. Impact data reported for cellulose acetate show an increase after six cycles at 510° F.

REPRODUCING MACHINE PARTS IN PLASTISOL FLEXIBLE MOLDS. Rubber Age *75*, 840 (Sept. 1954). A fast and economical method is reported for reproducing intricate machine parts and potting electronic components with low temperature cure epoxy resins using flexible molds made of vinyl plastisols. This new technique permits production runs of as much as 500 units at a cost of about $10.00 for molds compared to the high unit cost of metal molds for similar short production runs.

DIP MOLDING AND COATING WITH PLASTICS. Plastics (London) *19*, 333-34 (Oct. 1954). Dip molding and dip coating facilities are described. In dip molding, a metal former is moved slowly through a heating unit and dipped into a polyvinyl chloride

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solution where a coating of the material adheres. The formers are then passed through a curing oven and water-quenched, after which the moldings are pulled away from the formers. Typical products are cable connectors, flexible couplings, and dust covers. In dip coating, polyvinyl chloride in dispersion form and polyethylene in finely divided powder form are used. In the case of polyvinyl chloride, the article to be coated is heated in an oven, dipped into the polymer dispersion, and cured in an oven. In the case of polyethylene, the article is heated to 140 to 190° C., agitated in the powder either mechanically or by spraying, and then sintered in an infrared oven at 140° C. Polyethylene is preferred for coating because the finish is more durable and there are no drips, which facilitates production.

Advances in Drying of Paper Coatings With Far Infra-Red Radiant Heating. Paper Trade J. *138*, 108-09 (Nov. 12, 1954). Radiant heating is an efficient and reasonably-priced means of drying paper coatings. Electric far infra-red heating using the metal sheath heater is particularly effective. Far infra-red radiation is absorbed with almost equal speed by almost all colors giving nearly complete uniformity of heating. Infinitely variable temperature control is possible with an input controller whose on time is adjustable to a percentage that produces the desired constant temperature. Although the heater is thus energized in pulses, its thermal inertia smooths them out to maintain a constant temperature. Several input controllers can be used to give zone control of temperature.

## Applications

Experimental Asbestos Molded Wing. Brit. Plastics *27*, 302-303 (Aug. 1954). The molding of an experimental 10.5-ft. wing from asbestos-reinforced phenolic material is described. The wing consists of four moldings each stiffened on the inner face by integrally molded ribs. Molding of the test wing was carried out on a 1000-ton press in matched metal molds provided with means for heating and cooling the laminate during the molding cycle. It is estimated from test data that on a strength-weight basis, the molded wing is some 10% more efficient than an equivalent structure in aluminum alloy. Production costs would be lower, and it is further estimated that after development it would be possible to achieve an output of one complete wing in 2 hr. using a single set of tools.

Fibers. J. L. Vodonik, R. S. Casey, and C. S. Grove, Jr. Ind. Eng. Chem. *46*, 2076-83 (Oct. 1954). Scientific and technical developments during the past year in the field of fibers are reviewed. Considerable emphasis has been on synthetic fiber and cotton research, resulting in modifications that increased fiber utilization in industrial processes. Cyanoethylation of cotton has markedly increased many advantageous factors. Overexpansion of production facilities has shown itself in a depressed market, which can only be relieved by working with industry to provide new uses for fibers as materials of construction. New finishes, new coatings, and new treatments highlight these efforts to penetrate and open up potential new markets for increased fiber consumption. 77 references.

Filled Teflon for Dry Bearings. S. Ricklin. Materials & Methods *40*, 112-14 (Oct. 1954). Bearings that need no lubrication must have an exceptionally low coefficient of friction against the shaft material and must have high wear resistance. Four new filled-Teflon compositions known as "Rulon" have been developed that possess these properties to a high degree. In addition, these filled-Teflon materials possess other desirable properties for severe operating conditions, including chemical inertness, high electrical resistance, and low dielectric losses at relatively high temperatures. Low thermal conductivity and high coefficient of thermal expansion, however, make these materials most suitable where rubbing speeds are low or where provision is made for dissipation of heat. Current research may modify these limitations.

Vinyl Films for Textiles. Modern Packaging *28*, 106-11 (Nov. 1954). A 1-mil extruded vinyl chloride plastic film developed especially for textile wraps may solve many of the packaging problems of this industry. It offers transparency and reasonable cost without the brittleness and shattering under certain conditions experienced with other packaging films. Recent developments that have produced vinyl plastic film with excellent printability and machine handling despite its thin gage have made this use possible. Details of the printing process and sealing are presented.

Mix it in the Package. Modern Packaging *28*, 122-23 (Nov. 1954). A triple film envelope, made of polyethylene coated cellophane, with a rupturable membrane, permits the mixing of an epoxy resin with hardener in the field for use in insulating splices for electrical cable connections. The resin and hardener, separated by a thin membrane, can be kept in the plastic package for extensive periods; once catalyzed, the resin must be used immediately. This package will permit the extensive use of epoxy resins in the field, whereas its use has been previously limited to the manufacturer's plant.

Farnborough 1954 Show Reviewed. Plastics (London) *19*, 326-31 (Oct. 1954). Some of the applications of plastics materials in the aircraft industry, as shown at the 1954 Farnborough Air Show, are discussed and numerous photographs of these applications are shown. These include structural materials: various components, such as ducting and radomes, made from glass reinforced and asbestos reinforced laminates; acrylic components: various canopies; raw materials: several types of resins; cables and other electrical applications: cable insulation made of polyethylene, polyvinyl chloride, and polytetrafluoroethylene, and bushes, grommets and other small components made of polyvinyl chloride; interior fittings: various parts molded or vacuum formed from rigid polyvinyl chloride sheets, and upholstery made from saran.

## Coating

Coatings of Polyamide and Epoxy Resin Blends. M. M. Renfrew, H. Wittcoff, D. E. Floyd, and D. W. Glaser. Ind. Eng. Chem. *46*, 2226-32 (Oct. 1954). Coatings that can be air-dried or baked at mild temperatures to provide films with properties approximating those of quality coatings baked at high temperatures are described. Combinations of epoxy resins with certain polyamines of low molecular weight provide coat-

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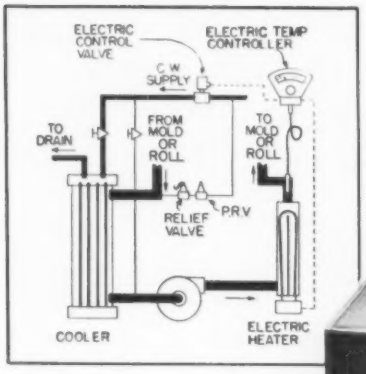


Schematic sketch of the control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits, MC-3 has 3 circuits.

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COMPLETELY redesigned, the new *Sarcotrol* heating and cooling unit is fully automatic as shown in the following list of features. It maintains even face temperatures by recirculating temperature-controlled water at high velocity through molds or roll jackets. Check *Sarcotrol's* features against any other unit *before* you buy.

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- **No need for special heat transfer liquids** — temperature-controlled water to 250° F. is recirculated at high velocity in closed system.
- **Independent circulating systems** — the Sarcotrol is available with one, two or three independent systems (see above sketch).
- **Simple, sensitive control** — one knob changes temperature control setting; sensitive thermostat (±1°) minimizes temperature lags; easy-to-read dial shows both desired and actual temperatures.
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- **Saves electricity and water** — the *same* thermostat regulates both *rate* of heat input and cooling; cuts out both when set temperature is reached.
- **Automatic heater protection** — heaters are automatically cut off when pump is shut down.
- **Many other features** — are listed in the *Sarcotrol* technical bulletin.

2081 F

Please advise if you are interested in automatic temperature control for molds or for rolls. Technical bulletin and case histories will be mailed to you by Sarco Company, Inc., Empire State Building, New York 1, N. Y.

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ings with highly attractive properties. These systems have practical limitations imposed by the short pot life of the mixture and the adverse physiological activity of the volatile amine curing agent. The polyamide-epoxy resin combinations offer substantial benefits from the point of view of convenience of handling. The mixtures demonstrate longer working life than amine-cured epoxy systems and carry a minimum of health hazards. Cost savings provide a financial incentive for attention by paint chemists. The polyamide-epoxy resin combinations provide films that are extremely flexible and have very high impact resistance. This high degree of flexibility is obtained at some sacrifice in chemical and solvent resistance as compared to the amine-cured epoxy resin systems. Baked systems provide more desirable properties than air-dried coatings, although the latter are superior in many respects to baked varnishes or alkyds. Gloss, adhesion, hardness, and lack of reactivity with pigments are outstanding properties of this new coating system.

### Properties

WEATHER AGING OF STYRENE AND PHENOLIC PLASTICS. C. H. Adams and J. R. Taylor. Mech. Eng. *76*, 803-807 (Oct. 1954), Rubber World *131*, 239-40 (Nov. 1954). The properties of unpigmented styrene, pigmented styrene, and a black pigmented, wood-flour-filled phenolic compound were determined before and after weathering in three locations: Florida, Arizona, and Massachusetts. In general, Florida weather was the most damaging to the physical properties of both styrenes and the phenolic material. The mechanical and electrical properties of unpigmented styrene were seriously degraded by exposure to outdoor weather for a period as short as three months. The degree of degradation was closely related with the amount of sunlight reaching the specimen. The weather resistance was significantly improved by the addition of a pigment to the styrene. The surfaces of both types of styrene were roughened by erosion after four years of exposure. Although the strength properties of the pigmented styrene showed little change over this period, the surface yellowed considerably. The phenolic compound was degraded mechanically and electri-

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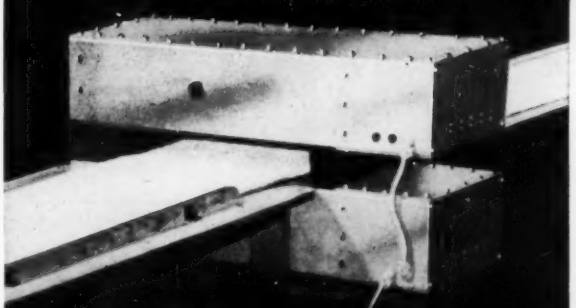

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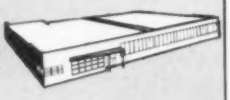

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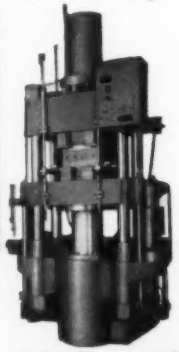

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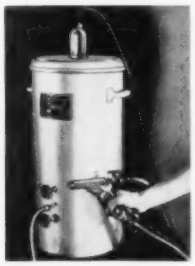

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cally by semi-tropical weather. Specimens aged in a hot, dry climate showed no appreciable changes in strength and electrical properties during the exposure period. The loss of weight of the exposed specimens may be attributed largely to continued cure, while the change in appearance was caused by surface erosion.

EFFECTS OF BIAXIAL STRAIN ON THE PROPERTIES OF ACRYLIC SHEET. S. J. Barker and A. W. Birley. Plastics (London) *19*, 344-47 (Oct. 1954). The effects of biaxial stretching on properties of polymethyl methacrylate sheet are reported, with results similar to those obtained in this country. The tensile properties, measured from −20° to +20° C., show a slight increase in tensile strength and modulus with increasing degrees of stretching. The extension at break increases with increasing degrees of stretching and then levels off. The impact strength and the resistance to stress-solvent crazing increase with increasing degrees of stretching. Birefringence measurements and the mica-like fracture of the highly stretched material suggest that the molecules are oriented to some degree in planes parallel to the plane of the sheet.

## Testing

DETERMINATION OF THE POLYVINYL ACETATE CONTENT IN COMPOUNDS USED IN FLOOR COVERINGS. E. Gollmer. Kunststoffe *44*, 383-84 (Sept. 1954). A test method for determining polyvinyl acetate is based on saponification and solution of the resulting polyvinyl alcohol in water. The resin content is obtained as the difference after the quantitative determination of the filler.

## Publishers' Addresses

*British Plastics:* Iliffe and Sons, Ltd., Dorset House, Stamford St., London S. E. 1, England.
*Chemical and Engineering News:* American Chemical Society, 1115 Sixteenth St., N. W. Washington, D. C.
*Industrial and Engineering Chemistry:* American Chemical Society, 1115 Sixteenth St., N. W. Washington, D. C.
*Kunststoffe:* Carl Hanser Verlag, Leonhard-Eck-Strasse 7, Munich 27, Germany.
*Materials and Methods:* Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.
*Modern Packaging:* Modern Packaging Corp. 575 Madison Ave., New York 22, N. Y.
*Paper Trade Journal:* Lockwood Trade Journal Co., Inc., 15 W. 47th St., New York 36, N. Y.
*Plastics* (London): Temple Press Ltd., Bowling Greene Lane, London E. C. 1, England.
*Product Engineering:* McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N. Y.
*Rubber Age:* R. T. Vanderbilt Co., Inc., 230 Park Ave., New York 17, N. Y.
*Rubber World:* Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.
*SPE Journal:* Society of Plastics Engineers, 513 Security Bank Bldg., Athens, Ohio.


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# U. S. PLASTICS PATENTS

**Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.**

ACRYLONITRILE. A. B. Craig (to Chemstrand). U. S. 2,696,478, Dec. 7. Polyacrylonitrile dissolved in 1-methyl-2-pyridone.

FOUNDRY CORES. W. Ossenbruggen and E. Konrad (to Farbenfabriken Bayer). U. S. 2,696,479, Dec. 7. Phenolic-resin-bonded foundry core.

POLYSILOXANES. A. F. Gordon and H. A. Clark (to Dow-Corning). U. S. 2,696,480, Dec. 7. Organopolysiloxanes containing phenylene groups.

POLYMERS. A. K. Schneider (to Du Pont). U. S. 2,696,481, Dec. 7. Polyesters of disalicylide.

POLYAMIDES. D. C. Pease (to Du Pont). U. S. 2,696,482, Dec. 7. Transparent polyamide.

MILL. J. Rehak, C. R. Wallace, and R. C. Seanor (to Adamson-United). U. S. 2,696,635, Dec. 14. Continuous mixing mill.

EXTRUDING. A. W. Meyer, P. C. Firing, and K. W. Pratt (to National Lead). U. S. 2,696,639. Dec. 14. Extruding and drying plastic materials.

EXTRUSION. M. Wienand (to Dynamit). U. S. 2,696,640, Dec. 14. Extrusion device.

INJECTION. W. H. Schwartz (to Lester Engineering). U. S. 2,696,641, Dec. 14. Injection cylinder.

PLASTICIZER. S. J. Hetzel (to Sun Oil). U. S. 2,697,045, Dec. 14. Cellulose derivatives plasticized with a 1,5-pentanediol diester of a 21-carbon aromatic acid.

PLASTICIZER. J. D. Brandner (to Atlas). U. S. 2,697,046, Dec. 14. Monophenyl ether of polyethylene glycol as plasticizer for cellulose acetate.

SAFETY GLASS. G. S. Stamatoff (to Du Pont). U. S. 2,697,053, Dec. 14. Laminating glass and polyvinyl butyral.

PLASTIC ARMOR. A. G. H. Dietz and F. E. Mooney (to U. S.). U. S. 2,697,054, Dec. 14. Plastic body armor.

MAT. R. E. Schwartz (to Vibradamp). U. S. 2,697,056, Dec. 14. Method of forming mat of resin-bonded glass fibers.

SEAL. F. J. Lasak (to General Electric). U. S. 2,697,058, Dec. 14. Metal-to-polyethylene seal.

THERAPEUTIC RESIN. E. L. Gustus. U. S. 2,697,059, Dec. 14. Hydroxy aromatic carboxylate resin absorption composition.

ION EXCHANGE. G. F. D'Alelio (to Koppers). U. S. 2,697,079-80, Dec. 14. Ion-exchange resins containing quaternary ammonium hydroxide groups.

MOLDING COMPOUNDS. C. C. Heritage (to Weyerhaeuser). U. S. 2,697,081-2-3, Dec. 14. Compositions of phenolic resins, and redwood bark components.

ADHESIVES. L. W. Eger (to Permacel). U. S. 2,697,084, Dec. 14. Polyvinyl ether adhesives.

MELAMINE. R. Lindenfelser and M. K. Kilthan (to American Cyanamid). U. S. 2,697,086, Dec. 14. Modified melamine-formaldehyde resin.

ACRYLONITRILE. T. E. Stanin and J. B. Dickey (to Eastman Kodak). U. S. 2,697,088, Dec. 14. Acrylonitrile polymer mixed with polyvinyl formal.

CATALYST. E. Farber (to Timber Engineering). U. S. 2,697,090, Dec. 14. Maleic acid cold-setting catalyst for urea-formaldehyde resin.

COPOLYMERS. A. S. Kidwell and G. P. Rowland (to Firestone). U. S. 2,697,091, Dec. 14. Copolymers of vinylidene chloride, trichloroethylene, and methyl acrylate.

INTERPOLYMERS. H. W. Coover, Jr., J. B. Dickey, and N. H. Shearer (to Eastman Kodak). U. S. 2,697,092, Dec. 14. 3-Methylenephthalide-acrylonitrile interpolymers.

CELLULAR BODIES. H. Lindemann, U. S. 2,697,255, Dec. 21. Producing foamed plastics.

COATING. M. E. Calkins and G. K. Greminger, Jr. (to Dow). U. S. 2,697,666, Dec. 21. Solution of methyl cellulose and N-acetylethanolamine in water.

SAFETY GLASS. R. A. Gaiser (to Libbey-Owens-Ford). U. S. 2,697,-675, Dec. 21. Plastic-glass laminates.

JOINT-SEALING. H. R. Beck and R. S. Detrick (to Koppers). U. S. 2,697,697, Dec. 21. Vinyl chloride-acetate copolymer composition.

SOLUTIONS. E. J. Kowolik, J. Downing, and J. G. N. Drewitt (to British Celanese). U. S. 2,697,698, Dec. 21. Polyacrylonitrile dissolved in nitrosamines.

PLASTIC WEB. J. D. Haskell (to Black-Clawson). U. S. 2,697,851, Dec. 28. Cooling freshly formed plastic film.

PLASTIC TUBING. J. Bailey (to Plax). U. S. 2,697,852, Dec. 28. Winding collapsible tubing.

PHOTOGRAPHIC FILM. F. E. Swindells, F. P. Alles, and W. R. Sauer (to Du Pont). U. S. 2,698,235-9-40-41-42, Dec. 28. Photographic film including a tripolymer of vinylidene chloride-acrylonitrile-itaconic acid.

SHEET MATERIAL. S. S. Miner and E. H. Clark (to U. S. Rubber). U. S. 2,698,273, Dec. 28. Heat-splicing thermoplastic sheet.

ADHESIVE. C. C. Heritage (to Weyerhaeuser). U. S. 2,698,307, Dec. 28. Adhesive of phenolic resin and rotted wood.

RESIN. S. B. Crecelius (to Devoe and Raynolds). U. S. 2,698,308, Dec. 28. Esters of resinous epoxide alcohols.

COATING. H. L. Thwaites and H. F. Hitchcox (to Standard Oil). U. S. 2,698,309, Dec. 28. Polyethylene coating for paper.

CATALYST. J. D. Robinson (to American Cyanamid). U. S. 2,698,-311, Dec. 28. Catalyzing polymerization with an emulsion of water-insoluble catalyst.

INHIBITOR. E. E. Parker (to Pittsburgh Plate Glass). U. S. 2,698,312,

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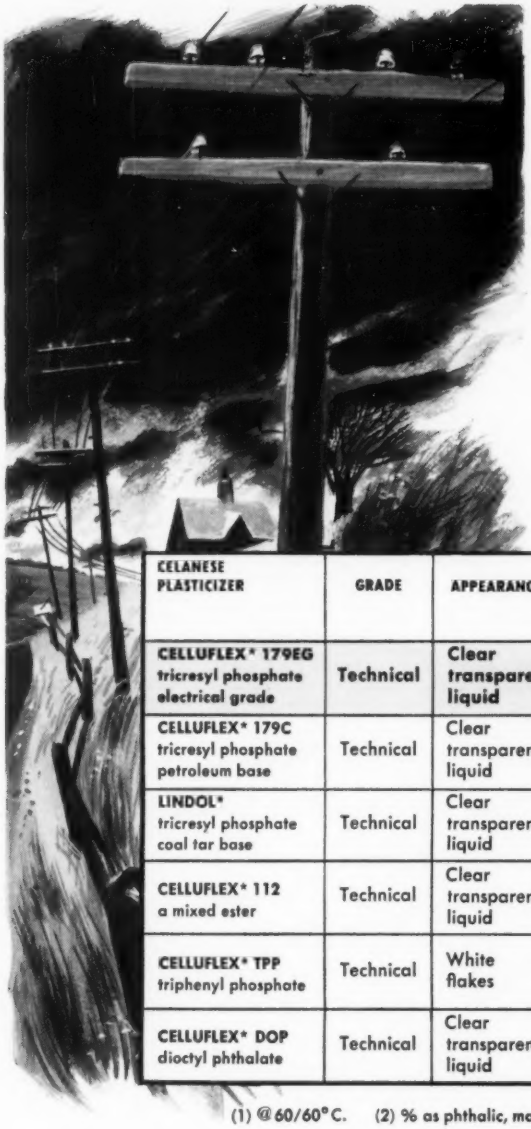

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|---|---|---|---|---|---|---|---|---|
| **CELLUFLEX* 179EG** tricresyl phosphate electrical grade | **Technical** | **Clear transparent liquid** | **150** | **1.145 ± .005** | **0.01 (3)** | **99** | **30** | **1.552 (5)** |
| **CELLUFLEX* 179C** tricresyl phosphate petroleum base | Technical | Clear transparent liquid | 150 | 1.165 ± .005 | 0.01 (3) | 99 | 30 | 1.553 (5) |
| **LINDOL*** tricresyl phosphate coal tar base | Technical | Clear transparent liquid | 75 | 1.165 ± .005 | 0.01 (3) | 99 | 30 | 1.556 |
| **CELLUFLEX* 112** a mixed ester | Technical | Clear transparent liquid | 40 | 1.210 ± .005 | 0.01 (3) | 99 | 30 | 1.560 (5) |
| **CELLUFLEX* TPP** triphenyl phosphate | Technical | White flakes | 20 (4) | 1.221 (1) | 0.003 (3) | 99 | 30 | 1.550 (6) |
| **CELLUFLEX* DOP** dioctyl phthalate | Technical | Clear transparent liquid | 50 | 0.985 ± .002 | 0.01 (2) | 98 | — | 1.4859 |

(1) @ 60/60°C. (2) % as phthalic, max. (3) % as phosphoric, max. (4) Molten (5) @ $n\frac{25°C.}{D}$ (6) @ $n\frac{60°C.}{D}$

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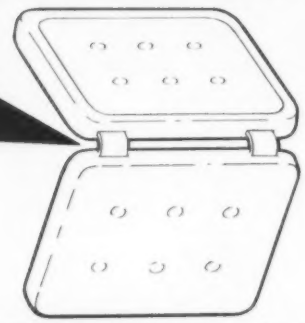

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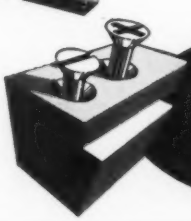

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Dec. 28. Polyester composition inhibited with 4-*n*-butyl catechol.

THERMOPLASTIC COMPOSITION. L. E. Daly (to U. S. Rubber). U. S. 2,698,313, Dec. 28. Composition of styrene-acrylonitrile resin with nitrile rubber and acrylate rubber.

SILANES. J. B. Rust (to Montclair Research and Ellis-Foster). U. S. 2,698,314, Dec. 28. Copolymer silanes.

RESINS. S. O. Greenlee (to Devoe and Raynolds). U. S. 2,698,315, Dec. 28. Complex epoxide resins.

COPOLYMERS. J. J. Giammaria (to Socony-Vacuum). U. S. 2,698,316, Dec. 28. Amine derivatives of copolymer acids.

RESINS. S. E. Ross and H. D. Noether (to Celanese). U. S. 2,698,317, Dec. 28. Polysulfone resins.

FURFURYL ALCOHOL. L. H. Brown and P. A. Wells, Jr. (to Quaker Oats). U. S. 2,698,319, Dec. 28. Polymers of furfuryl alcohol.

MOLDING. I. J. Amo (to M and W). U. S. 2,698,460, Jan. 4. Injection molding.

EXTRUSION. Y. Conwell, W. F. Busse, and V. P. Carracciolo (to Du Pont). U. S. 2,698,463, Jan. 4. Extruding polyethylene.

MOLDING. J. S. Wilson (to M and W). U. S. 2,698,464, Jan. 4. Gate-free injection molding.

TOY. G. Miller. U. S. 2,698,496, Jan. 4. Inflatable plastic figure.

BUFFING WHEEL. E. L. Lotz (to Harvel). U. S. 2,698,504, Jan. 4. Glass fabric that is bonded with silicone resin.

FELT. D. M. Hawley and J. C. Williams (to Hawley Products). U. S. 2,698,558, Jan. 4. Felted, resin-bonded glass fibers.

RESINS. A. M. Schiller and T. J. Suen (to American Cyanamid). U. S. 2,698,787, Jan. 4. Urea resins for use in the production of wet-strength paper.

### Twenty-Mule Team Material

Omitted from the credits in "Premiums for the New Sales Era," p. 161, January 1955 MODERN PLASTICS, was the fact that Mule Team wagons are molded of Tenite acetate by Eastman Chemical Products Inc.


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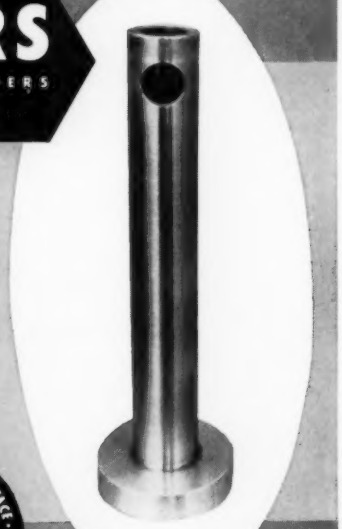
- Xaloy minimizes contamination.
- Xaloy liners give longer service.



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# NEW MACHINERY AND EQUIPMENT

**Printing Equipment**—Four- and six-color printing on flexible film, in a continuous single printing plus a slitting operation, is accomplished by the Filmprinter. The equipment includes a drying system, a semi-automatic splicing arrangement at both ends, and tension equipment designed especially for use with polyethylene and other extensible materials. Speeds range between 200 and 300 ft./min. *Kidder Press Co., Inc., Dover, N.H.*

**Thread Inserts**—Wire thread inserts of large pitch diameter and wire size, said to provide strong, permanent threads in soft materials (plastics, woods, aluminum, etc.), come in standard sizes from 4-40 to 1½-12. Inserts to provide threads for polyethylene pipe are included in the line. *Heli-Coil Corp., Danbury, Conn.*

**Pipe Marking**—Permanent marking of plastics pipe and shapes on a production basis is accomplished with a new branding unit, available for continuous or intermittent marking.

Plastics pipe in diameters from ½ to 4 in. can be marked. Changing the holding fixture permits marking of bars, angles, flats, half rounds, and other extruded shapes. Operation is fully automatic. Thermostatic control maintains correct temperature of the branding die to produce uniform, clean impressions. *Geo. T. Schmidt, Inc., 4100 Ravenswood Ave., Chicago 13, Ill.*

**Heat Control**—The problem of detecting breakdown in extruder barrel heating bands in time to avoid loss of plastic raw material has been solved by connecting ammeters in series with each heating coil between the master zone control and the individual barrel heater. Thus, as soon as any one heater begins to break down, its malfunctioning is instantly indicated on the panel meter. Besides preventing defective extrusions (and resultant waste of matrial), this arrangement also permits immediate localization of the defective band, without recourse to disassembly of the extruder barrel.

The control panel shown in the accompanying illustration was especially built for Hartig Engine & Machine Co. by West Instrument Corp., using ammeters supplied by Simpson Electric Co. The small Simpson meters across the center panel are connected in series with heater coils. These, in turn, are banked with the large West meters (top of panel) into heater zones.

The three companies concerned in the development of this unit state that the equipment is suitable for a variety of extrusion and injection applications. *Hartig Engine & Machine Co.* (extrusion machines), *488 Hillside Ave., Hillside, N. J.; West Instrument Corp.* (industrial panel controls), *525 N. Noble St., Chicago, Ill.;* and *Simpson Electric Co.* (industrial panel meters), *5200 W. Kinzie St., Chicago 44, Ill.*

**Control panel of meter set-up for detection and localization of electrical breakdown in extruder barrel heating bands**

**Winding Equipment**—Constant-tension hydraulic winder is a self-contained unit claimed to wind any thickness, width, weight, or type of material at a wide range of linear speeds, tensions, and roll build-ups. The unit is installed by aligning it with the process machine from which it is to wind, and connecting it to the power supply. Once the desired tension has been set on a dial, no further attention is said to be required from the operator regardless of the number of rolls wound. *Temco Winders, Inc., Providence, R. I.*

**Grinding Machine**—Unit is designed primarily for grinding vinyl, polyethylene, plastisols, and all other elastomerics, in addition to all other thermoplastics. Because of its slicing action, it is said to cut all of these soft plastic materials without fluffing. Occupying a floor area of 30 by 18 in., the unit has an unrestricted throat opening of 5⅜ by 8½ inches. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

**Compression Press**—Model "H" is a 70-ton automatic compression press with 18- by 18-in. electrically heated and water-cooled platens. Temperature of each platen is controlled by thermoswitches. The hydraulic ram has a 9-in. stroke, is operated by push-button-controlled, motorized pressure pumps. An electric cycle timer opens the press automatically at preselected intervals. Down stroke is controlled by an adjustable, electrically operated trip mechanism. *Pasadena Hydraulics, Inc., 279 North Hill Ave., Pasadena 4, Calif.*

**Infra-Red Heaters**—All-metal far infra-red electric heaters can be used to replace infra-red glass lamps. Two types are available, one with standard medium screw base, the other with bi-post terminals.

The heaters may be cycled by means of an input controller, making it possible to synchronize heating cycles with speed of conveyor or size of work. This, the producer of the all-metal units claims, is not possible with conventional glass bulb infra-red lamps, except with con-

MODEL
H-250

NEW!

# VAN DORN
## 2½ Oz. Automatic Press

Check these outstanding features of this ultra-modern Van Dorn injection press:—

**GREATER CAPACITY**— Up to 2½ oz.; smaller pieces at faster cycles.

**HI-SPEED PERFORMANCE** — Plasticizes material at 22 lbs. plus per hour.

**FASTER PRODUCTION**—Will attain up to 720 cycles per hour (dry run).

**HIGHEST EFFICIENCY**—Due to water cooling of injection plunger, transfer hopper and oil cooler.

**ACCESSIBILITY**— Due to simple platen clamp device for purging to change material or color.

**MORE SAFETY**— Mold hydraulic mechanism makes press non-operative unless molded part is completely ejected.

**SIMPLER OPERATION**—Due to automatic, adjustable material metering device.

**MULTIPLE OPERATIONS**—Minimum operator attention by use of larger hopper and light that indicates when press needs attention.

**SELECTIVE CONTROL**—Merely throw toggle switch to operate press semi-automatically.

**DEPENDABILITY**— Because of all-steel construction and Van Dorn's established reputation in the plastics machinery field.

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***and this Van Dorn model is the lowest priced press in its class!***

**WRITE FOR COMPLETE DATA ON MODEL H-250 AND OTHER EQUIPMENT SHOWN**

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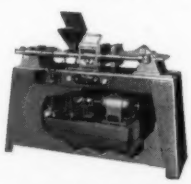
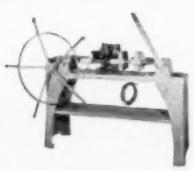
2-oz. capacity.

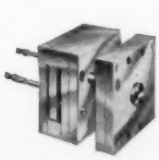


**POWER OPERATED, LEVER CONTROLLED PRESSES**
2-oz. and 1-oz. models



**MANUALLY OPERATED PRESS**
1-oz. For small jobs, training, etc.

**PLASTIC GRINDER**
Grinds up rejects, waste, etc., for re-use.

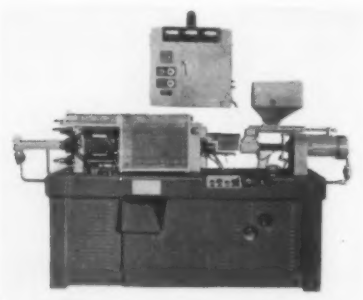


**MOLD BASES**
Available from stock.

siderably more expensive voltage control equipment.

The far infra-red elements are fully insulated. They are available in ratings from 375 to 1200 watts for 120- and 240-v. operation. *The Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.*

**Injection Machine**—Model 75, completely automatic 3-oz. injection molding machine, said to be especially suitable for molding containers, tumblers, and other parts requiring long mold openings, has mold opening stroke ranging from 8 to 16 inches.



**Moslo's automatic 3-oz. injection molding machine accommodates 9- by 18-in. mold blanks. Control cabinet is shown at top.**

Of horizontal construction, Model 75 has four tie rods, with micromatic adjusting nuts for even distribution of pressure on four points of toggle clamp. Operating speed is 740 cycles/hr., dry run; plasticizing capacity is 50 lb./hour. A metered material hopper holds 50 lb., and has a window for visual indication of material level. Model 75 accommodates 9- by 18-in. mold blanks; mold casting area is 40 sq. inches.

The materials cylinder, of the Moslo-Radee type, is said to handle all thermoplastics, including nylon and vinyls; nylon requires a special nozzle.

An automatic compensating adjustable feed device controls quantity of material admitted. Counter timer is provided for packing feed cylinder. Time cycle is controlled by five timers, including one Cycl-Flex timer that controls the mold safety device, and one Allen Bradley repeat cycle timer for continuous fully automatic operation. An additional timer controls a hydraulic injection booster arrangement.

During operation, mold clamp operating cylinder remains on low pressure until mold faces meet; if there is an obstruction in the mold, a safety timer times out, setting up a circuit through a flasher to a warning light.

All valves of the machine's hydraulic system are mounted on a hydraulic manifold. All electrical equipment, including three West pyrometric control instruments, timers, terminal blocks, fuse blocks, etc., are in a two-door steel cabinet designed for wall or stand mounting.

A metal safety guard covers the complete top of the clamp assembly. A sliding type metal safety gate engages a limit switch before the machine can be operated. When the gate is open, the machine is inoperative. *Moslo Machinery Co., 2443 Prospect Ave., Cleveland 15, Ohio.*

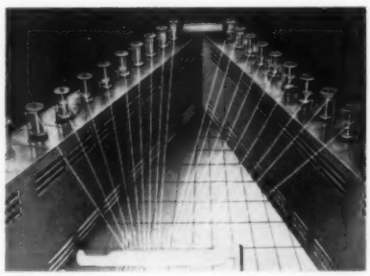
**Cooling Equipment**—Portable liquid cooler provides cooling in an operating range of 60 to −20° F., with an accuracy of ±¾° F. The unit has a ¾-hp. Freon compressor, an air-cooled condenser, a 40 to 120 gal./hr. brine pump, a 4-gal. brine tank, and a precision indicating-type thermostat. Over-all size is 28 in. wide by 22 in. deep by 24 in. high. Shipping weight is approximately 250 pounds. Advantages claimed for the unit are short set-up time, elimination of handling of dry ice, no need for auxiliary control equipment. To operate, a hose from the cooler is run to the apparatus, the electrical cord is plugged into a wall socket, the thermostat is set, and the unit started. *Mayer Refrigerating Engineers, Inc., Lincoln Park, N. J.*

**Extrusion Cutter**—With blade capacity up to 2¼ in., extrusion cutting machine is claimed to cut up to 7080 pieces of extruded plastics, rubber, and other material per minute. Adjustments are available permitting a speed as slow as one cut every 6½ minutes.

For fewer than 150 cuts per minute, a retractable knife is pivoted near the rim of a flywheel and swings in an arc. For greater number of cuts per minute, one, two, four, or eight fixed knives are attached to the flywheel. These knives have blades up to 2½ in. long. Blades in action never travel less than about 100 in./sec. (peripheral speed), and ordinarily about twice that speed. This avoids "backing-up" of the material against the knife, or the building up of internal back-pressure which may distort the freshly extruded hollow section. It also aids in obtaining square cuts.

A combination of electronic, electrical, and mechanical elements in the controls permits stepless variation of the interval between cuts over the entire range. *Foster-Allen, Inc., 628 South Ave., Garwood, N. J.*

**Spooling Equipment**—For rewinding plastics filaments, spooling machine is available with 10, 20, or more individual spooling units. The drive of all spooling units is separate from the operation of the thread-guide mechanism. This mechanism operates from a common, variable speed drive, but all spooling units are driven by individual Alquist motors. These motors maintain a constant tension on the filaments, in proper relation to the speed of the extruder and the growing diameter of the spools, without interference from the thread-guide movements. *H. H. Heinrich Co., 111 Eighth Ave., New York 11, N. Y.*



**Heinrich's filament spooling equipment uses individual motors to separately drive each spooling unit**

**Air Feed**—For attachment to heads of any Walker-Turner drill press with up to 6 in. spindle travel, air feed has automatic feed-and-retard action for a variety of continuous production operations. The unit contains no hydraulic components, but operates through a 100% pneumatic microvalve that gives the spindle its automatic feed-and-retard action. For special cases, a hydraulic check valve is available as an accessory.

The air feed can be installed in about 10 min. without need for machining or making electrical connections. It is said not to interfere with

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There is no substitute for the sound experience and superior design of Welding Engineers Inc. processing equipment *when leaders in the plastics industry plan for their futures.* On both engineering and management levels, Welding Engineers Inc. Compounder-Extruders continue to be first choice . . . for new equipment, for replacement and expansions. The record speaks for itself.

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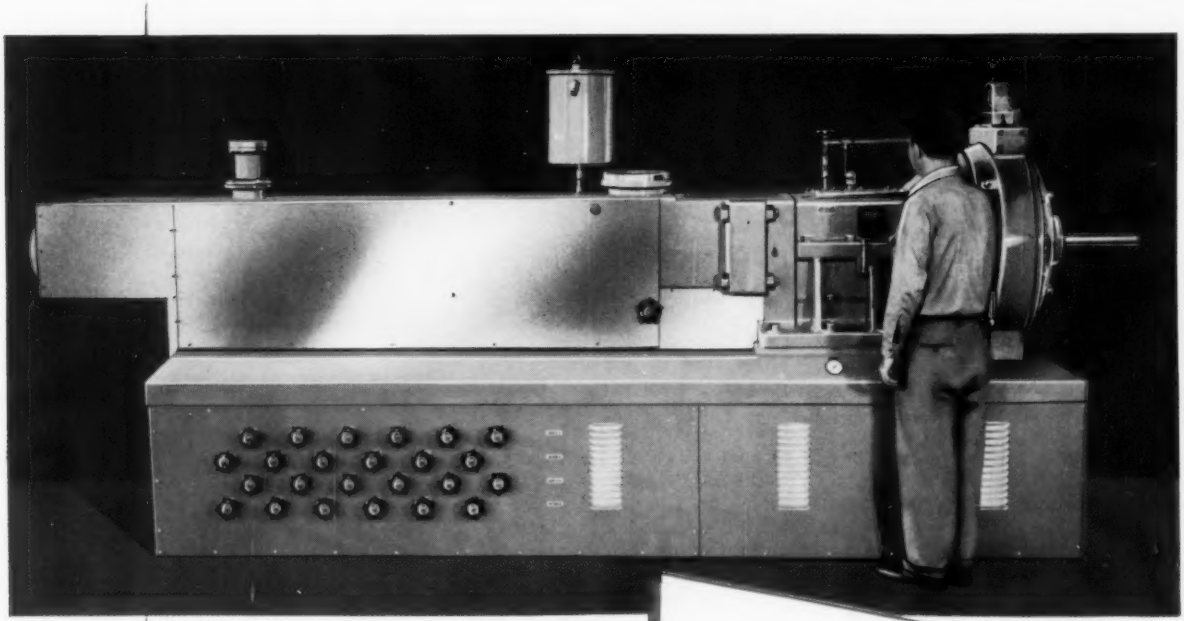

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**Plastic flanges reinforced with L·O·F Garanized® Woven Roving Mat possess high wet strength, plus freedom from corrosion**

Here's another dramatic illustration of the basic advantages offered by plastics reinforced with L·O·F Garanized roving. Mr. C. J. Larsen, superintendent of Basic Tool Engineering Company, Inc., of Los Angeles, California, says:

"We chose woven roving mat made of L·O·F Garanized roving, in the manufacture of this pipe flange, because of its superior wet-strength characteristics. This was most important to its underwater use in the new Los Angeles Water Works aeration plant."

**You, too, can utilize** the superior reinforcing properties of L·O·F roving in your product. L·O·F roving gives excellent results for preforming, for reinforcing mat or chopped strand. Even-tension packages for rod-stock applications offer the same superior reinforcing properties.

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**TOLEDO 1, OHIO**


the normal functioning, swing, or position of the drill press to which it is attached.

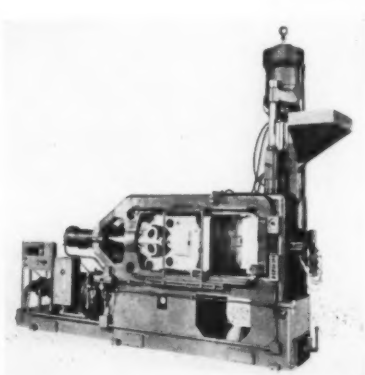
Rate of feed is controlled by means of a check valve and a series of set-screw adjustments. Release of a valve-stop brings the air feed back to single-cycle operation. Removal of two plugs from the air cylinder converts the unit for conventional hand operation. The manufacturer claims that the accuracy of the feed will hold indefinitely within 0.003 inch.

Feed pressure at the drill point averages 14 times greater than the air pressure. For example, a ⅛-in. drill may be operated at 5 to 7 p.s.i. to deliver between 70 and 100 lb. at the drill point. Air pressure may be regulated to suit production requirements. *The Kearney & Trecker Corp., Walker-Turner Div., Plainfield, N. J.*

**Injection Machine**—Model L-2-20 is a 20-oz. machine which is claimed to have locking tonnage and mold area equal to most other 32-oz. machines. It will mold 20 oz. of polystyrene or 80 cu. in. of any other granular thermoplastic per shot.

The unit has a hinged vertical injection assembly; it uses an internally heated cylinder with narrow band heaters on the outer wall and four-zone pyrometer control. Movable platen is 40 in. wide, with 28¼-in. clearance between beams. Linkage is double toggle in multiple shear.

The unit is said to be readily adaptable for molding nylon. Special-purpose accessory circuits, such as for completely automatic molding,



Lester-Phoenix's 20-oz. injection machine has hinged vertical injection assembly, is adaptable to molding nylon

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ANOTHER PATENTED **VacForm** DEVELOPMENT

# Water Cooled Vacuum Forming

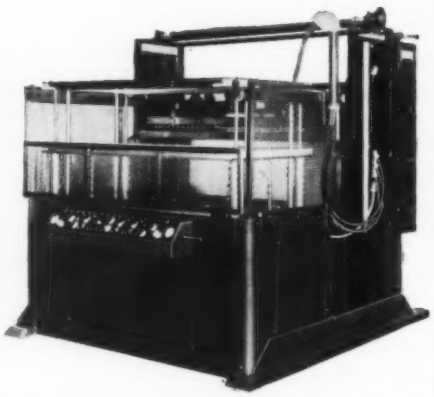
## NEW WATER-COOLED MOLD CLAMP FRAME

- **Gives faster continuous operation without frame overheating or binding**
- **Prevents slipping or tearing out of plastic being formed**
- **Assures perfect registration of mold with preprinted designs; avoids rejects**

**These exclusive advantages** are now possible through the development of a water-cooled mold clamp frame assembly for all VacForm presses. This basic improvement in vacuum forming prevents overheating of the frame. Output is safely speeded up for continuous forming, with no slipping or distortion of the plastic sheet; no production delays from binding of the frame.

**Only VacForm presses** add water cooling to these profit-making features: push-button operation . . . automatic or manual cycles . . . continuous mass production with quality control . . . vacuum or drape forming from inexpensive male or female molds . . . deep draws with no loss of detail . . . complete mold size adjustability . . . quick progress from design to finished production.

**VACFORM MODEL 50-20**
One of the presses on which the new water-cooled frame is now standard equipment. This model is adjustable for sheets up to 50" x 24" and draws as deep as 15".



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are optionally available. *Lester-Phoenix, Inc., 2711 Church Ave., Cleveland 13, Ohio.*

**Registration Control**—Photoswitch Control Type 23LF3 Model 1006 provides registration control continuously over both high- and low-speed ranges. It is claimed to respond instantly to the appearance of a mark printed on material moving past it at speeds from 15 to more than 500 ft./minute. Series 42 scanner, supplied with the control, consists of a light source, lens system, phototube, and amplifier, all mounted in a single housing. Combined weight of registration control and scanner is 20 pounds. Specifications of the unit are as follows:

Supply: 115 v., 60 cy.; consumption 35 watts.

Contacts: single-pole, double-throw relay; 10 amp., 115 v. a-c non-inductive; 5 amp., 230 v. a-c non-inductive.

Speed of response: responds to an impulse of less than 0.0005 sec.; relay de-energizes within 0.012 sec. after reset contacts are opened.

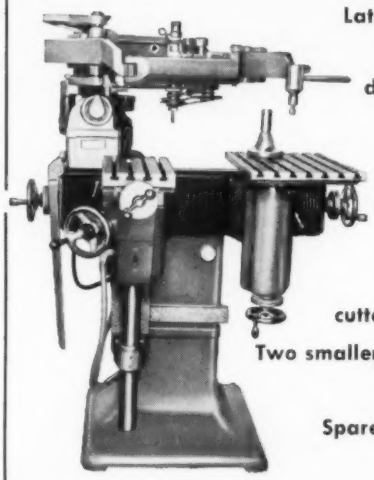
Linear speed of controlled material: minimum 3 in./sec.; maximum depends on size of registration mark; e.g., a mark only $\frac{1}{32}$ in. wide on material moving at 50 ft./sec. will operate the control. *Electronics Corp. of America, Photoswitch Div., 77 Broadway, Cambridge 42, Mass.*

**Speed Indicator**—Direct pick-up electric tachometer for attachment to Speed-Trol variable speed drives includes a signal generator and a speed indicator. Standard calibration on the indicator is in r.p.m., but it can also be furnished calibrated in various other units of production, e.g., cu. ft./min.; gal./hr.; ft./min., etc. *Sterling Electric Motors, 5401 Telegraph Rd., Los Angeles 22, Calif.*

**Hydraulic Booster**—Continuous-action, automatic reciprocating air-hydraulic booster, said to be capable of delivering an unlimited amount of high-pressure fluid for the operation of hydraulic cylinders, operates from ordinary plant air compressor. The unit consists of an air cylinder with a hydraulic discharge pressure chamber at each end, thus delivering a pressure output stroke in both directions.

At the end of each stroke, the piston assembly contacts an actuator

## ALEXANDER DIE-SINKERS
### for 2 or 3 dimensional work



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A solvent-free
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The complete compatibility of BARCA-10 avoids oil surfaces and bleeding under ultra-violet light. High stabilizing capacity offers extremes in age resistance and color pigment life.

BARCA-10 acts as a true secondary plasticizer without lubricant value.

Because BARCA-10 is a liquid, low in volatiles, it can be added at any stage of the mixing process. Based on barium and cadmium, and free from lead and sulfur, BARCA-10 eliminates common sources of blackening, odor and toxicity.

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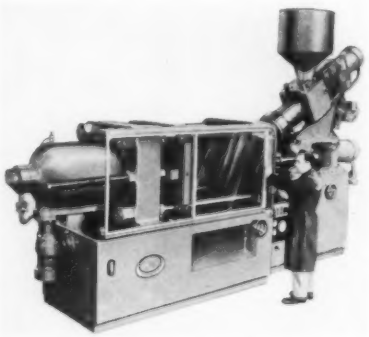
DEECY PRODUCTS CO.
PLASTICIZERS STABILIZERS
120 Potter St., Cambridge 42, Mass.

button on the inside of the cylinder. The movement of this button operates the actuator which, in turn, shifts the position of a four-way, two-position double-pilot-operated valve, causing reversal of air flow and corresponding reversal of booster stroke.

The unit is available in all ratios to give pressures up to 10,000 p.s.i. and over. It is recommended by the manufacturer for operations requiring high holding pressure. *Miller Fluid Power Co., 2040 N. Hawthorne Ave., Melrose Park, Ill.*

**Pelletizer**—Extruded thermoplastic strands can be cut into uniform pellets by high-capacity pelletizing machine. The machine has variable speed drive transmission to accommodate a complete range of extruder capacities. *Ball & Jewell, Inc., 22 Franklin St., Brooklyn 22, N.Y.*

**Injection Machine**—Fully hydraulic, preplasticizing-type injection molding machine is rated at 64-oz. shot capacity (polystyrene) and 425-ton clamping force. The machine has a radial piston-type, motor-driven



**Watson-Stillman's 64-oz. injection machine has 425-ton clamping pressure, plasticizing capacity of 200 lb./hour**

pumping unit, semi-automatic control, adjustable injection speed, independent control of injection and clamping pressures, internally heated plasticizing cylinder with four-zone temperature control, and a plasticizing rate of 200 lb. of polystyrene per hour.

Specifications are as follows: stroke—24 in.; daylight opening—40 in.; and die space—25 by 45 in. *The Watson-Stillman Co., Div. of H. K. Porter Co., Inc., 109 Aldene Rd., Roselle, N. J.*

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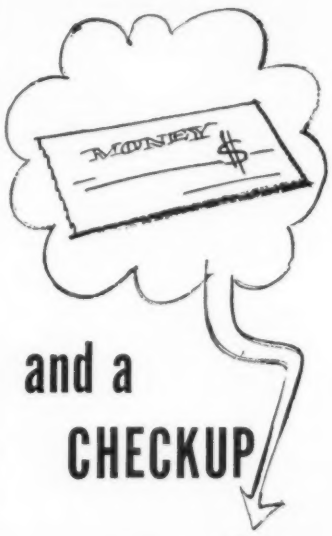
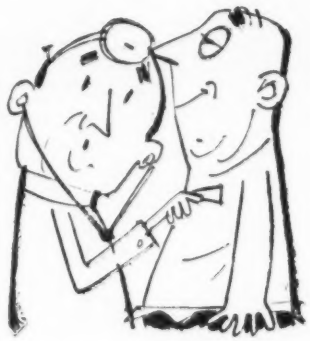
with a CHECK




and a
CHECKUP



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to help others...
a checkup
to help yourself.

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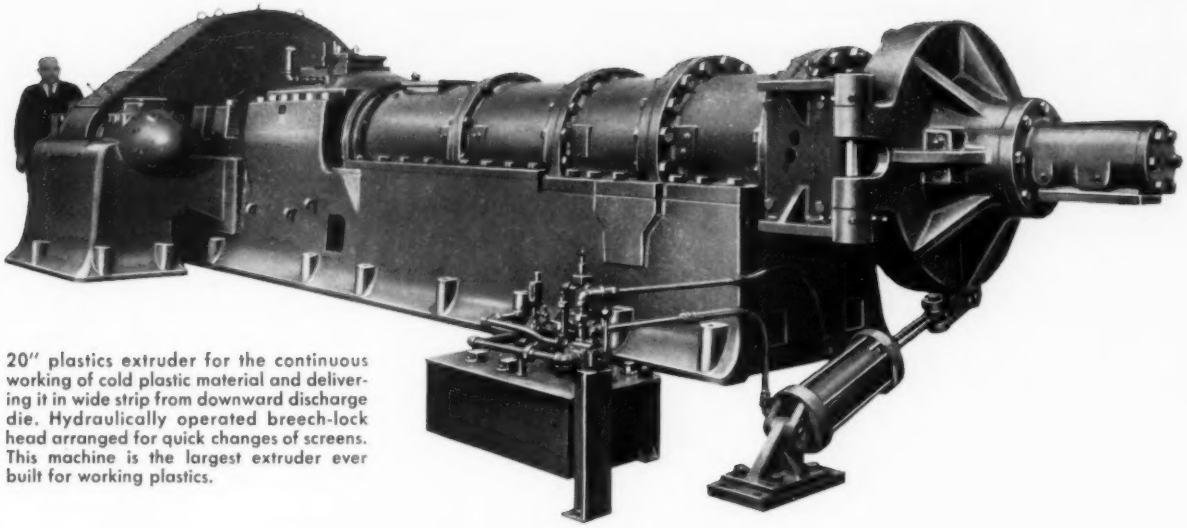
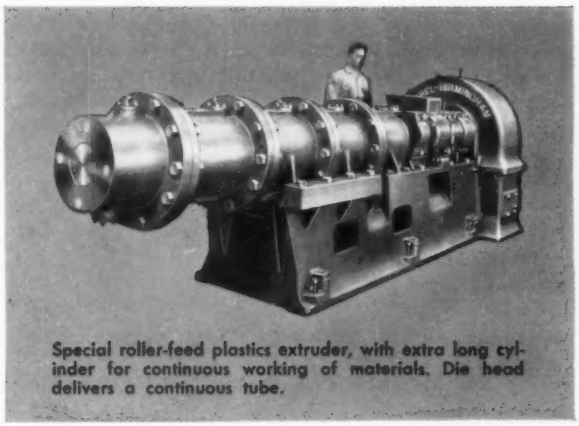


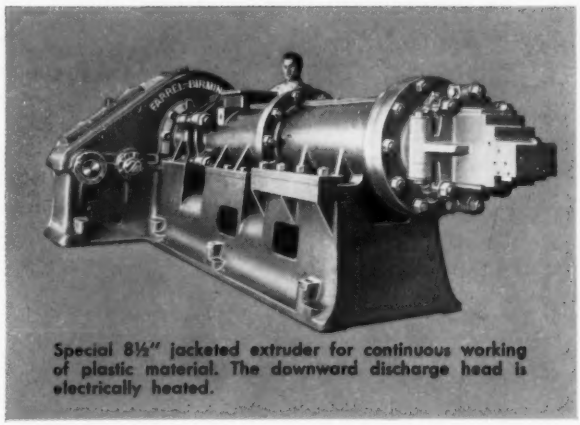
20" plastics extruder for the continuous working of cold plastic material and delivering it in wide strip from downward discharge die. Hydraulically operated breech-lock head arranged for quick changes of screens. This machine is the largest extruder ever built for working plastics.

# FARREL-BIRMINGHAM PLASTICS EXTRUDERS

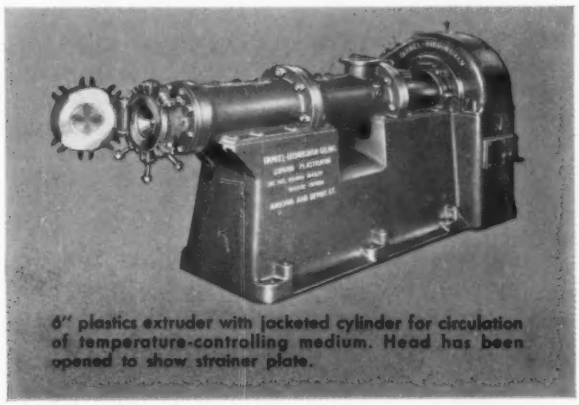
## *built to your requirements*



Special roller-feed plastics extruder, with extra long cylinder for continuous working of materials. Die head delivers a continuous tube.



Special 8½" jacketed extruder for continuous working of plastic material. The downward discharge head is electrically heated.



6" plastics extruder with jacketed cylinder for circulation of temperature-controlling medium. Head has been opened to show strainer plate.

Farrel-Birmingham has developed a complete line of heavy-duty, screw-type extruding machines for processing plastics.

They are designed to blend and fuse the ingredients of various plastics into a homogeneous whole, to process plastic reclaim and to transfer and form materials discharged from the Banbury mixer.

The various features of the machines are dictated by the use intended for the machine and the particular requirements of the application. Screw diameters range up to 24". Write for information about extruders for specific applications.

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FB-1000

**F-B PRODUCTION UNITS**—Banbury Mixers, roll mills, calenders, extruders, plasticators, hydraulic presses and other equipment.

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# BOOKS AND BOOKLETS

**Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.**

**"Silicones and Their Uses," by R. R. McGregor**

Published in 1955 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 302 pages. Price: $6.00.

A comprehensive summary of available information on properties, preparation, and applications of silicones, addressed to engineers, designers, and others interested in these chemicals. The volume is not intended for chemists, and its language has been kept as non-technical as consistent with a proper understanding of the subject. The larger portion is given over to descriptions of the available commercial products, their properties, and how they can be used. Representative industries and the uses they are making of silicones are tabulated. Techniques of application are shown. A short discussion of the price situation is included.

**"Metal-to-Metal Adhesives for the Assembly of Aircraft," edited by Richard G. Newall**

Published in 1955 by Western Business Publications, 274 Brannan St., San Francisco 7, Calif. 64 pages. Price: $4.00.

A collection of 12 papers presented at the Conference on Metal-to-Metal Adhesives, sponsored jointly by the University of California and the Aircraft Industries Association of America, held during September 1954. The papers cover fabrication, design, testing, flight experience, and theoretical aspects of adhesive-bonded metal structures.

**"Directory of Commercial and College Testing Laboratories"**

Published in 1955 by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 48 pages. Price: $1.00.

Successor to the *Directory of Commercial and College Laboratories* published in 1947 by the U. S. Dept. of Commerce, the present directory put out by A.S.T.M., lists the locations of testing laboratories equipped and prepared to undertake testing on a commercial or fee basis. Information is given concerning 278 testing laboratories and their 151 branches. Also presented is a list of the laboratories of 86 colleges that are prepared to do testing under certain conditions. Research and consulting laboratories are not listed unless they are also engaged in testing on a commercial basis.

**"Conversion Factors and Tables," 2nd edition, edited by O. T. Zimmerman and Irvin Lavine**

Published in 1955 by Industrial Research Service, Inc., Dover, N. H., 501 pages. Price: $5.00 (foreign $5.50).

Anyone who has occasion to convert units of one system of measurement into those of another will not want to be without this book. For here, collected in tabular form, are conversion factors for units of weight, velocity, density, viscosity, pressure, energy, length, temperature; mechanical, electrical, thermal, nautical, and astronomical units; refrigeration and air conditioning, hydraulic, heat-transfer, photometric, apothecary, and power units, and many others. If you want to convert grams per liter to grains per U. S. gallon; horsepower to B.t.u.; ounces per degree Fahrenheit to grams per degree Celsius; kilograms per square millimeter to pounds per square inch . . ., in fact, most any conceivable conversion problem, this work will have the answer. The authors have also included a section on conversion factors for foreign units of measurement, and a five place logarithm table.

**"A Short Textbook of Colloid Chemistry," by B. Jirgensons and M. E. Straumanis**

Published in 1955 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 420 pages. Price: $8.00.

In this volume for text use and reference, the authors first provide a brief survey of fundamental terms, classifications, and elementary laboratory methods used in colloidal chemistry. From there they proceed to a more exhaustive study of the important classical and modern methods used in studying colloidal systems, e.g. light scattering, electrophoresis, ultra-centrifugation, viscosity analysis, electron microscopy, X-ray analysis, and others. The book emphasizes the dependence of various properties of colloidal systems on the sizes and shapes of the constituent colloidal particles and macromolecules, with both organic and inorganic colloids used as examples.

**Machinery catalog**—Bulletin No. 195 describes and illustrates plasticators, pelletizers, extruders, strainers, strainer-extruders, tubing machines, German mixers, and special-purpose machines, designed and built for use principally in the plastics and rubber industries. *Farrel-Birmingham Co., Inc., Ansonia, Conn.*

**Reinforced plastics** — Structural strength and economy of manufacture attainable with glass reinforced polyester resins is described and illustrated in this brochure. Military aircraft structures, auto body shells, building partitions, and similar applications are described. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 300 Madison Ave., New York 17, N. Y.*

**Viscosity conversion**—Chart provides convenient means of translating any viscosity measurement into seven other standard units. Methods of measuring viscosity vary from industry to industry and, even in the same field, from one company to another. This conversion nomograph has been designed to minimize the problems caused by the lack of standardization: it provides a means of rapidly converting from one system to any other. *Nopco Chemical Co., Harrison, N. J.*

**Job directory**—This guide is an annual publication with a two-fold aim: 1) to help companies put their "story" before graduating engineers, and 2) to help the engineer survey the job market. 129 companies are participating in the first issue. The directory includes an index section where companies indicate the types of engineers they want. It also lists the plant, sales, and research

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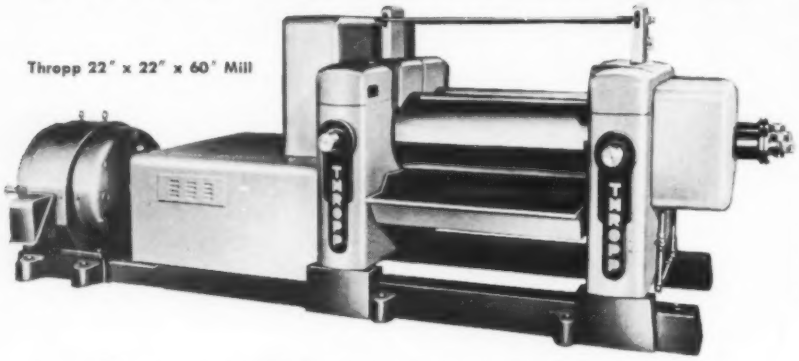

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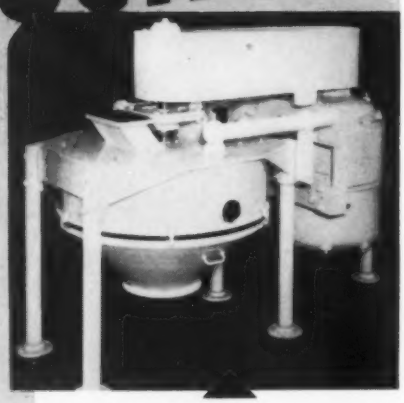

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laboratory locations by cities and states. Another section lists the companies interested in undergraduates for summer jobs. $2.25. *Decision, Inc., 105 E. Fourth St., Cincinnati 2, Ohio.*

**Write-on tape**—Pressure-sensitive plastic tape that can be written on is described in Folder No. 5. Suggested uses are indicated. The tape may be applied to any smooth surface, and written on with pencil, stylus, or ball-point pen. Pressure of the writing instrument alone causes non-erasable writing to appear. Data on available colors and widths are included. *Labelon Tape Co., Inc., 450 Atlantic Ave., Rochester 9, N. Y.*

**Dry-film lubrication**—How colloidal dispersions have been used successfully for dry-film lubrication is described in Bulletin No. 438. Various combinations of lubricating solids and carriers and their specific application in machine lubrication, metal working, foundry operations, and other manufacturing processes are presented. *Acheson Colloids Co., Div. of Acheson Industries, Port Huron, Mich.*

**Cementing styrene**—Techniques for cementing molded styrene plastic are presented in this 20-page product information booklet. Included are sections on cement types, methods of application, joint design, clamping devices, classes of bonds, and manufacturers of cements. *Monsanto Chemical Co., Springfield, Mass.*

**Plasticizers**—Latest issue of *Kabelitems* contains an article on properties of plasticizers and their relation to electrical compounding. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N. Y.*

**Filtering equipment**—Principles of operation and advantages of plate and frame pressure filters (also known as filter presses) are described in this 32-page booklet. The brochure also presents a complete line of such presses and catalogs various accessories for use with the equipment. Data to determine filter press requirements as well as cost of various types of presses are included. The presses, claimed to require only

unskilled labor for operation, separate solid particles from a mixture of liquids and solids by means of a permeable medium which allows the liquid to pass through and retain the solids. *T. Shriver & Co., Inc., 810 Hamilton St., Harrison, N. J.*

**Nylon-6**—This brochure presents technical information on the chemical and physical properties of Grilon, a polyamide of the nylon-6 type based on caprolactam. Data on injection molding and extruding of the material and suggested uses are given. *Alfred C. Toepfer, Inc., 1 Broadway, New York 4, N. Y.*

**Plastic pipe**—How to use and specify rigid plastic pipe and fittings is the subject of this 12-page catalog. The catalog lists a line of ½- to 4-in. normal-impact and high-impact unplasticized polyvinyl chloride pipe and fittings. It also presents properties and characteristics data as well as drawings and specifications of solvent-type fittings and injection molded threaded fittings. A corrosion chart, classifying more than 275 corrosives rated according to desirability of use of vinyl pipe, and recommended and non-recommended applications, is included. Contains installation, cost, and ordering information. *Alpha Plastics Inc., 14 Northfield Rd., West Orange, N. J.*

**Hydrogen peroxide vapor**—Bulletin 62 describes the possibilities that exist for technological use of hydrogen peroxide vapor and outlines means of vapor generation. Tables, graphs, and a bibliography are included. *Becco Chemical Div., Food Machinery and Chemical Corp., Station B, Buffalo 7, N. Y.*

**O-ring catalog**—Catalog AD-148 gives design information, recommended pressures, and available materials for both dynamic and static applications. It also contains a list of standard O-ring sizes available from stock. *The Garlock Packing Co., Palmyra, N. Y.*

**Teflon filters**—Bulletin T-115 lists performance data for porous Teflon filter media and information on complete filter units using fluorocarbon material. Criteria for proper selection of filter areas required are presented. *Porous Plastic Filter Co., 30 Sea Cliff Ave., Glen Cove, N. Y.*

**Financing**—This reference brochure describes commercial financing, including such types as accounts receivable financing, old line factoring, export-import, buy-out of a partner or new business, consumer finance, motion picture and television, and re-discount financing. Services offered by a factoring and commercial finance company are presented. *A. J. Armstrong Co., Inc., 60 E. 42nd St., New York 17, N. Y.*

**Sandwich structures**—Fabrication problems involved in the production of intricate sandwich-type aircraft components are discussed in this non-technical bulletin. Structures discussed include a sandwich-type rudder, a honeycomb trailing edge, and a variety of thin-wall, fibrous glass ducting. *Narmco Manufacturing Co., 930 W. Grape St., San Diego 1, Calif.*

**Static electricity**—Technical Service Bulletin No. 1 covers various aspects


Just as there'll always be a Broadway and the need for lights to strengthen its spirit — so also — there'll always be a need for strong plastics and Claremont Fillers to provide the strength factors! As we see it, there are two types of finished plastics — passive and active. Passive plastics need no strength . . . they're light, thin framed and basically decorative. In them, muscle would be a waste of strength. On the other hand, compression molded

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pieces are active plastics. They're handled, they do work. They comprise metal components molded in place. They're threaded, tapped, undercut, multi-walled and recessed. Such volumes require strength—high impact strength against shock or breakage — the kind of graded, stepped-up muscle building strength which Claremont Cotton Fillers are furnishing to the industry's best known and most widely used heavy-duty formulations!

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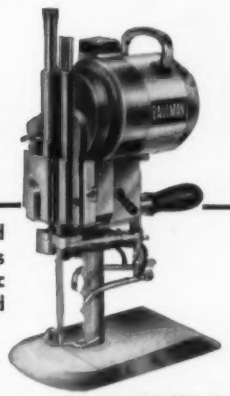

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for extrusion. Special quality for the manufacturer of cables, etc.

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for fishing lines, the manufacture of rope, and for woven technical fabrics.

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of static electricity created by friction on plastics and how it can be controlled. A coating said to overcome problems associated with the accumulation of static electricity charges on plastics surfaces is described. *Logo, Inc., 13799 South Avenue "O," Chicago, Ill.*

**Plastics for electronics**—Portfolio of technical bulletins covers a line of casting resins, plastic foams, vacuum tube coatings, impregnating resins, laminating resins, potting compounds, plastic cements, and plastic shapes for use in electronics. Information on properties, specifications, applications, casting, curing, and finishing are given. Price list is included. *Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.*

**Diamonds**—Technical information on new developments in industrial diamond technology, including diamond abrasives in powder and compound forms, is presented in this four-page folder. Also described is a diamond compound kit made up of nine small jars each containing ½ g. of diamond compound of varying particle size and concentration. *Diamond Tool Research Co., Inc., 380 Second Ave., New York 10, N. Y.*

**Film catalog**—Motion pictures which have been produced on various phases of the plastics industry and are available for public showing are listed in this catalog. These films cover varied subjects from plastics raw material through manufacturing processes to the finished product. A brief description of each film, the terms and conditions of release, and the name of the company or agency from which it can be obtained for showing are included. *The Society of the Plastics Industry, Inc., 67 W. 44th St., New York 36, N. Y.*

**Cement for vinyls**—Data sheet describes properties and uses of a solvent-type bonding agent for cementing most of the commonly used vinyl plastics. The cement is said to be effective with flexible and rigid vinyl sheets, molded sections, and extruded pipe. *Schwartz Chemical Co., Inc., 326 W. 70th St., New York, N. Y.*

**Reinforced plastics**—Bulletin GRP-1 presents technical data on custom-molded reinforced plastics parts. High-pressure molding techniques,

which permit economical production of complicated shapes with metal inserts if required, are described. Data on matched-metal molding for mass production of relatively simple shapes with uniform cross-sections, are also given. *American Hard Rubber Co., 93 Worth St., New York 13, N. Y.*

**Hot melts**—Uses of molten coatings in the paper and packaging industries are outlined in this folder. Chief advantage claimed for these coatings is that they are completely solid and thus contain no solvent. For application, they are melted (the same way wax is) and applied to a web by an applicator roll. Metering is accomplished by an equalizer rod. No drying or heating equipment is required. *Boler Petroleum Co., 121 Broad St., Philadelphia 7, Pa.*

**Fire prevention**—Two booklets dealing with industrial fire protection have been published by the National Board of Fire Underwriters. "Your Plant's Fire Protection" is a working guide to acquaint management with the need for fire safety, the basic principles of fire protection, and ways to safeguard plants. "The Big Industrial Fire—Your Problem" examines the factors that have made industrial fires the problem it is today and presents suggested remedies that can be applied by management. Both booklets are available from *The Society of the Plastics Industry, Inc., 67 W. 44th St., New York 36, N. Y.*

**Fibrous glass**—Specifications, performance, and packaging of a line of glass fibers are presented in this four-page folder. Described in detail are textile yarns for electrical insulation; yarns and rovings for plastic reinforcing; and Microlite insulation for thermal and acoustical applications. Folder also includes a description of quartz Micro-Fibers, said to be the first quartz ever synthesized in fibrous form. It withstands 2800° F. *Glass Fibers, Inc., 1810 Madison Ave., Toledo 1, Ohio.*

**Release agent**—Bulletin No. 427 discusses the use of colloidal graphite as a parting compound for glass molding, on clutch plate separators, as anti-weld coatings and gasket coatings, as anti-seize for screw threads, and in corrugated boxboard manufacture, rubber molding, foundry work, and other industrial operations. Specific dispersion formulations and techniques of application are presented. *Acheson Colloids Co., Div. of Acheson Industries, Port Huron, Mich.*

**Industrial chemicals**—An alphabetical listing of all the industrial chemicals carried by one company is presented in this 24-page brochure. A brief history of the company and photographs of several of its plants are included. *The Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio.*

**Benzoate**—Technical Bulletin F-8109 gives information on properties; shipping container contents; resin solubilities; and applications of *n*-butyl benzoate as a solvent, as an extractant, and as an intermediate for benzoate esters and alkyd resins. The chemical is used as a solvent in heat-set inks and baked metal finishes. It is of interest as a solvent for silk-screen printing inks, as a softening agent in the preparation of vinyl laminates, and as an ingredient of dye carriers for polyester fibers. Since it dissolves pentachlorophenol and *beta*-naphthol, *n*-butyl benzoate can be used in the preparation of wood-treating and weed-killing concentrates. *Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

**Finishing**—Bulletin 974 describes a pellet deflasher for finishing of molded thermosetting articles. The unit operates by subjecting plastics parts to gentle tumbling action under an energetic shower of soft-grit pellets made of crushed apricot pits, or crushed nut shells, or a mixture of both. Typical case histories are presented. *American Wheelabrator & Equipment Corp., 1254 S. Byrkit, Mishawaka, Ind.*

### S.P.E. Conference Correction

In our advance report of the program of the S.P.E. Eleventh Annual Technical Conference, MODERN PLASTICS, February 1955, p. 128, there was an error in the listing of the moderator of the Fluorocarbon Panel. This panel was moderated by George H. Koch Jr., of Oak Engineering Co., Oaklyn, N. J., which company is active in the designing and building of plastic molds and molded parts.


*Precision!*

**The highly efficient, handcrafted, extruder screw illustrated below was developed and installed by Killion Co. for one of the largest extrusion manufacturers in the country.**

The story behind this development started when the manufacturer, after research, decided upon a plastic heretofore unused for his particular application. This plastic was ideal for the product if it could only be extruded to meet the schedule set up by the Production Department. The machinery existed in the plant but the component parts just couldn't deliver the goods—this condition necessitated re-designing of the components. The most important was the proper design and manufacture of the feed screw. Here is where the Killion Co. entered the picture.

**Condition "A"**
Variable pitch diameters were needed to meet the new compression ratio called for to work the pellets to a plasticized controlled delivery. All threads were precision made and lead changes were held to thousandths of an inch.

**Condition "B"**
Special temperature and contamination conditions had to be met. These problems were overcome by the use of special steel and the maintainance of an absolute uniform depth-hardness.

**Condition "C"**
The over-all screw length of 120" was needed. Due to design limitations this length required piecing. This was accomplished without loss of strength or build up of stress.

**Condition "D"**
Since no screen or strainer could be used, the tapered end section had to be used to control the delivery. This condition was met by an accurately matched taper, insuring a controlled rate of flow.

**Condition "E"**
The extruder cylinder and screw had to be cleaned between runs. The screw quill was specially designed to facilitate speedy removal.

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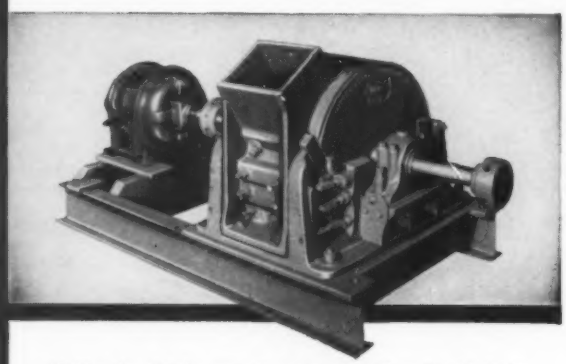
**M&M PLASTIC GRINDERS**



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# Production of

FOR the purpose of this report, production is the sum of the quantities of materials produced for consumption in the producing plant for transfer to other plants

**PLASTICS AND SYNTHETIC RESIN PRODUCTION IN**
**From Statistics Compiled**

| *Materials* | *Total p'd'n. first 12 mos. 1954* | *Total sales first 12 mos. 1954* |
|---|---|---|
| CELLULOSE PLASTICS:[a] | | |
| Cellulose acetate and mixed ester | | |
| Sheets, under 0.003 gage | 17,784,894 | 17,525,548 |
| Sheets, 0.003 gage and over | 12,239,469 | 12,845,930 |
| All other sheets, rods, tubes | 5,809,074 | 5,343,096 |
| Molding, extrusion materials | 76,562,500 | 75,548,025 |
| Nitrocellulose sheets, rods, tubes | 5,266,376 | 4,908,530 |
| Other cellulose plastics | 5,561,631 | 5,014,288 |
| PHENOLIC AND OTHER TAR-ACID RESINS: | | |
| Molding materials[a] | 177,876,753 | 168,416,848 |
| Bonding and adhesive resins for: | | |
| Laminating (except plywood) | 63,501,028 | 43,322,406 |
| Coated and bonded abrasives | 9,171,611 | 11,031,993 |
| Friction materials (brake linings, clutch facings, etc.) | 15,689,496 | 14,805,749 |
| Thermal insulation (fiber glass, rock wool) | 35,209,532 | 36,632,620 |
| Plywood | 29,990,773 | 28,839,598 |
| All other bonding and adhesive uses | 13,044,105 | 13,276,959 |
| Protective-coating resins | 23,528,641 | 21,068,559 |
| Resins for all other uses | 27,621,743 | 25,028,537 |
| UREA AND MELAMINE RESINS: | | |
| Textile-treating and textile-coating resins | 35,871,036 | 32,679,012 |
| Paper-treating and paper-coating resins | 20,078,920 | 19,020,494 |
| Bonding and adhesive resins for: | | |
| Plywood | 77,217,297 | 73,053,450 |
| All other bonding and adhesive uses, including laminating | 25,273,380 | 23,803,650 |
| Protective-coating resins | 28,048,594 | 21,467,226 |
| Resins for all other uses, including molding | 66,797,385 | 64,465,960 |
| STYRENE RESINS: | | |
| Molding materials[a] | 325,105,367 | 309,378,418 |
| Protective-coating resins | 85,013,350 | 81,623,325 |
| Resins for all other uses | 89,783,068 | 83,646,676 |
| VINYL RESINS, total[b] | 516,628,765 | 516,744,379 |
| Polyvinyl chloride and copolymer resins (50 percent or more polyvinyl chloride) for: | | |
| Film (resin content) | | 69,947,796 |
| Sheeting (resin content) | | 55,867,362 |
| Molding and extrusion (resin content) | | 146,971,059 |
| Textile and paper treating and coating (resin content)[c] | | 49,545,619 |
| Flooring (resin content) | | 34,885,111 |
| Protective coatings (resin content) | | 23,676,213 |
| All other uses (resin content) | | 34,446,914 |
| All other vinyl resins for: | | |
| Adhesives (resin content) | | 27,061,719 |
| All other uses (resin content) | | 74,089,904 |
| COUMARONE-INDENE AND PETROLEUM POLYMER RESINS | 192,894,444 | 202,429,594 |
| MISCELLANEOUS: | | |
| Molding materials[a, d] | 204,112,499 | 183,999,845 |
| Protective-coating resins[e] | 6,858,608 | 3,700,642 |
| Resins for all other uses[f] | 125,283,195 | 129,740,541 |

* Dry basis designated unless otherwise specified.
** Partially estimated. † Revised.
[a] Includes fillers, plasticizers, and extenders. [b] Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c] Includes

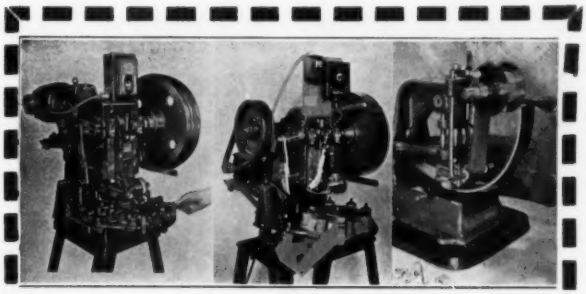
# Plastics Materials

of the same company, and for sale. Sales include only the quantities involved in bona fide sales in which title passes to the purchaser.

**POUNDS* FOR NOVEMBER AND DECEMBER 1954 by U. S. Tariff Commission**

| *November*** | | *December*** | |
|---|---|---|---|
| *Production* | *Sales* | *Production* | *Sales* |
| 1,440,704 | 1,640,774 | 1,811,467 | 1,422,203 |
| 1,130,829 | 1,206,500 | 1,294,223 | 1,218,296 |
| 524,391 | 545,807 | 556,437 | 485,752 |
| 7,349,725 | 7,428,040 | 6,469,934 | 6,267,549 |
| 315,947 | 390,334 | 329,106 | 400,452 |
| 508,377 | 386,704 | 451,918 | 433,302 |
| 14,723,825 | 15,540,741 | 14,814,249 | 14,998,261 |
| 5,428,658 | 3,931,598 | 5,068,584 | 3,200,844 |
| 1,099,794 | 1,196,370 | 990,252 | 1,111,783 |
| 1,508,155 | 1,404,941 | 1,652,842 | 1,392,741 |
| 3,238,273 | 3,511,021 | 3,372,080 | 3,458,390 |
| 3,202,244 | 3,035,879 | 3,160,192 | 3,110,255 |
| 944,968 | 1,033,013 | 1,122,360 | 1,095,370 |
| 2,015,746 | 1,669,677 | 1,792,122 | 1,562,234 |
| 2,747,481 | 2,463,199 | 2,829,395 | 2,810,589 |
| 3,202,054 | 3,199,596 | 3,689,311 | 3,616,746 |
| 1,633,692 | 1,697,991 | 1,836,581 | 1,805,929 |
| 7,403,032 | 6,577,595 | 6,273,823 | 6,677,690 |
| 2,816,943 | 2,580,264 | 2,858,923 | 2,652,429 |
| 2,491,074 | 2,020,686 | 2,682,443 | 2,247,734 |
| 6,225,767 | 6,470,252 | 5,685,794 | 5,622,876 |
| 30,229,256 | 28,099,117 | 28,150,502 | 26,958,329 |
| 6,922,181 | 6,925,854 | 6,543,791 | 7,732,241 |
| 6,265,291 | 5,969,394 | 7,054,559 | 6,602,706 |
| †46,531,997 | †49,018,840 | 49,772,577 | 47,366,103 |
| | 6,856,700 | | 6,087,286 |
| | 4,131,709 | | 3,963,145 |
| | 14,057,107 | | 14,849,788 |
| | 4,536,696 | | 4,548,223 |
| | 4,099,058 | | 3,795,968 |
| | 2,130,621 | | 2,066,473 |
| | 3,653,266 | | 3,267,542 |
| | †2,235,423 | | 1,866,579 |
| | 7,318,260 | | 6.921,099 |
| 18,670,357 | 18,094,881 | 17,061,143 | 17,229,298 |
| 22,196,116 | 17,523,028 | 24,358,492 | 17,057,791 |
| 255,249 | 232,959 | 380,051 | 282,756 |
| †11,008,286 | †12,825,973 | 11.746.310 | 11.487,054 |

data for spreader and calendering-type resins. [d] Includes data for acrylic, polyethylene, nylon, and other molding materials. [e] Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins. [f] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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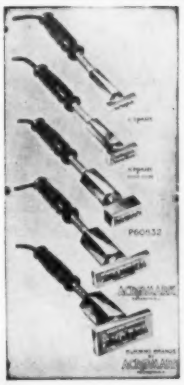

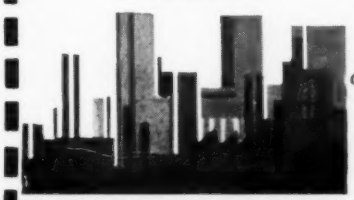

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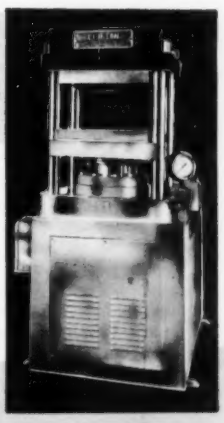

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### It's a great new control form . . . available only in Wheelco's new Model 407

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## Water Reservoir

FLEXIBLE vinyl windshield washer reservoirs now being offered by Chrysler Corp. for installation on their new model automobiles completely eliminate the old problem of bottle breakage. Unlike the glass containers which frequently shattered during the normal course of car use, the vinyl reservoir will not break when accidentally struck with tools or even when the automobile is being bounced over rough, unpaved roads.

Breakage during shipment to the automobile manufacturer is also eliminated. In addition, the vinyl container can stand up to freezing temperatures without shattering and is unaffected by greases, oils, acids, or other corrosive chemicals it is apt to come in contact with under the hood of the car.

The bag-like plastics containers are made by heat sealing a panel of unsupported vinyl sheet and a panel of vinyl coated cotton fabric together and adding a rigid vinyl neck. For the convenience of the automobile owner, the level of the liquid in the reservoir can be easily observed through the unsupported vinyl sheet panel side. The smooth surface of the unsupported vinyl sheet also permits instructions for using the container, and other pertinent information, to be clearly printed directly on the sheet.

CREDITS: The reservoir is fabricated for Chrysler Corp. by Electro Plastics Fabrics, Inc., Pulaski, Va., using Geon vinyl resins supplied by B. F. Goodrich Chemical Co., Cleveland, Ohio.

Windshie'd washer solution is stored in flexible vinyl container under hood

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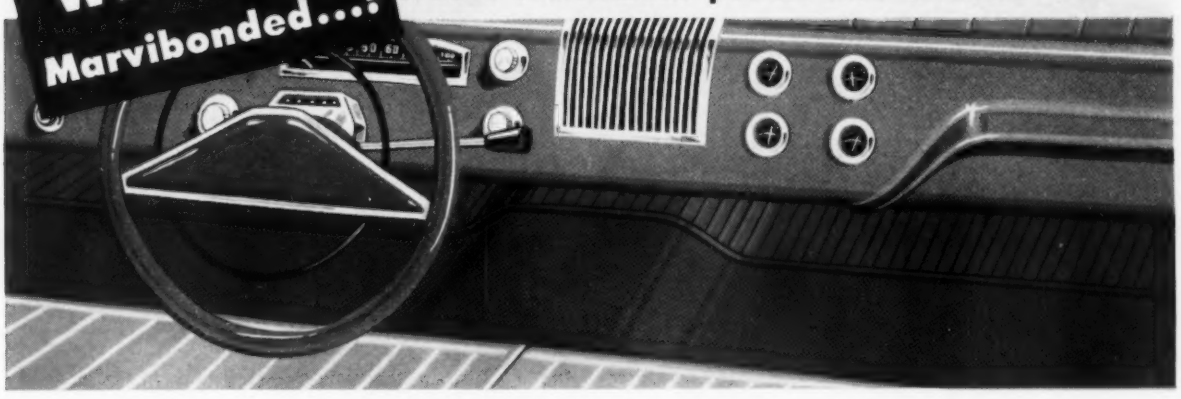
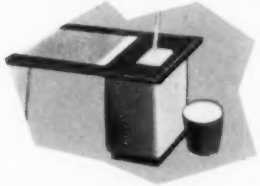


vending machine housings



waste baskets

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air conditioner cabinets

Window moldings and dashboards of Marvibonded laminates could be permanently clad with vinyl material to match door upholstery and seat trim. And practically any choice of texture is possible–from glare-free matte finishes to rich leather-like grains.

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What's more, the vinyl surface would always be warm and pleasant to the touch. Marvibonding ends problems of rust from moisture condensation. And it helps to deaden sound, as well as insulate against squeaks from metal to metal contact.

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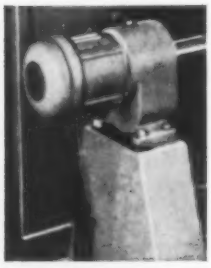

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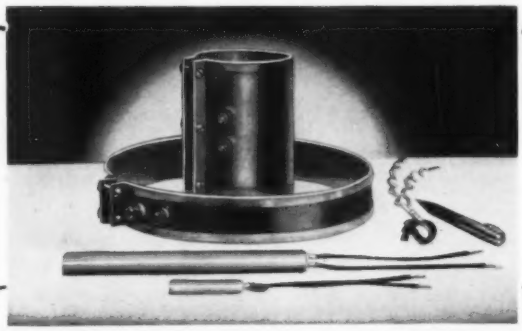

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Polyethylene ring inside phenolic cap eliminates need for threaded glass jar

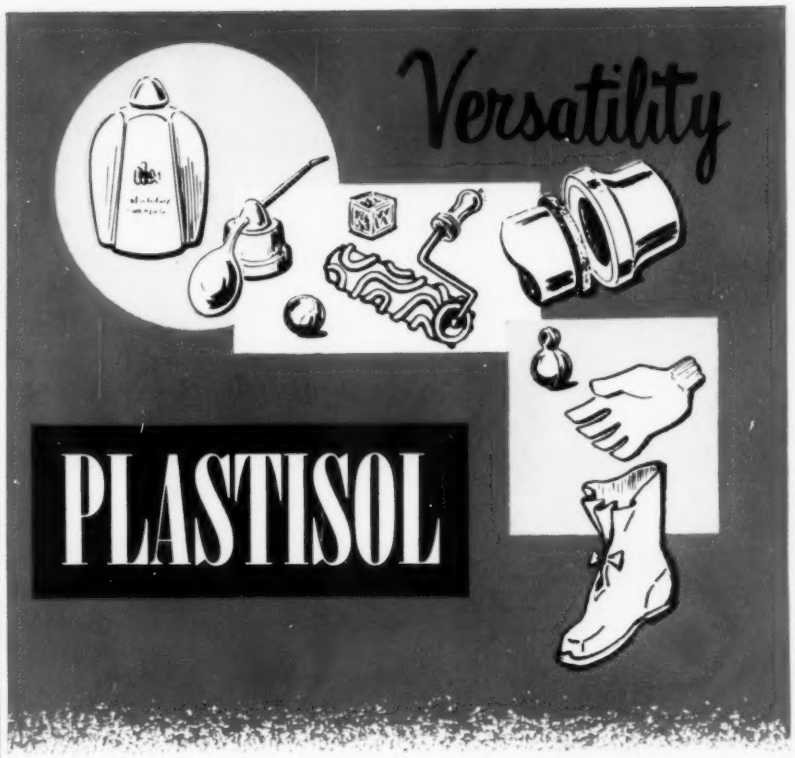
## Phenolic Cap

THE resiliency of polyethylene and the ruggedness of molded phenolic are effectively teamed up in the design of a new type of rubber cement dispenser. The cap for the dispenser is molded of phenolic and incorporates a polyethylene ring around its inside rim which eliminates the need for threads on the lip of the glass bottle.

In selecting plastics to replace the conventional metal cap, the manufacturers of the new dispenser were especially attracted by the adaptability of the material to modern design in keeping with the non-conventional hexagonal shape of the glass bottle itself. The bulb-shaped cap is molded in one piece of phenolic in a two-cavity mold. A molded-in stem projecting downward from the top inside of the cap accommodates the wooden handle of the brush and around the inside rim of the cap is a molded-in recess into which the polyethylene ring is press-fit. The ring is injection molded separately in a six-cavity mold.

Because of the adhesion between the polyethylene ring and the lip of the glass bottle, the cap can be secured in place with finger-tip pressure to provide an effective seal against evaporation. When the dispenser is ready to be used, it is just as easy to remove the cap and the attached brush with a simple twist of the hand.

CREDITS: The dispenser is produced by Haberule Publishing Co., Norwalk, Conn. Molds for the cap and ring are supplied by Stricker-Brunhuber Corp., New York, N. Y. Phenolic for the cap and polyethylene for the ring are both supplied by Bakelite Co.

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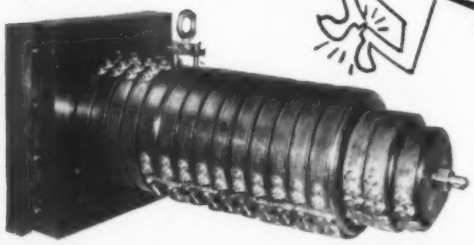

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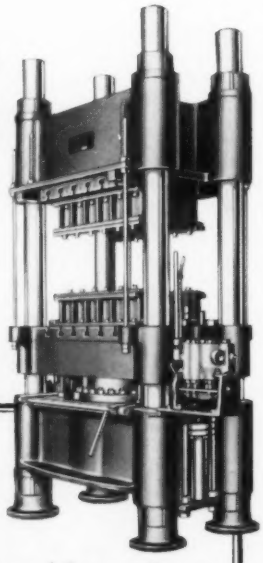

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# Auto Repairs With Reinforced Plastics

BY PATCHING sheet metal auto bodies with epoxy resin impregnated-fibrous glass cloth, savings in repair costs of as much as 70% can be effected, thereby enhancing the trade-in and resale value of used cars. A leading manufacturer of low-priced automobiles developed the economical new method to aid local dealers in repairing rusted-out and dented panels at a minimum cost in materials, time, labor, and equipment.

The repair kit consists basically of the liquid epoxy resin, a can of hardener, and strips of fibrous glass cloth. According to the manufacturers, epoxy resin was chosen for this application because of its exceptional adherence to sheet metal surfaces—a quality which combines with the strength of the glass cloth to produce a patch usually stronger and more durable than the surrounding metal. The excellent chemical resistance of the epoxy resin also enables the repaired area to withstand corrosion by moisture, weathering, salt water, and even acids and alkalies.

A rusted-out area of an auto body that costs about $80 to repair by the conventional but difficult metal patch and solder finishing methods can be reconditioned at a cost of about $24 in labor and materials. A typical body repair takes little more than an hour and is relatively simple.

First, the area to be repaired is cleaned with a solvent and by sanding to remove loose scale, rust, paint, etc. Then, while this area is being heated under ordinary household-type heat lamps, the epoxy resins are mixed with their hardeners and patches of glass cloth are cut large enough to overlap the repair area (Fig. 1). Glass cloth saturated in the resin mix is applied in successive layers over the area. Heat lamps are again applied to cure the resin and harden the patch in about 15 minutes (Fig. 2). Using a disk sander and file, the surface of the epoxy-fibrous glass laminate can be ground down to conform with the contour of the surrounding area (Fig. 3). Paint can then be applied following the same procedures that are commonly used for conventional metal body repairs.

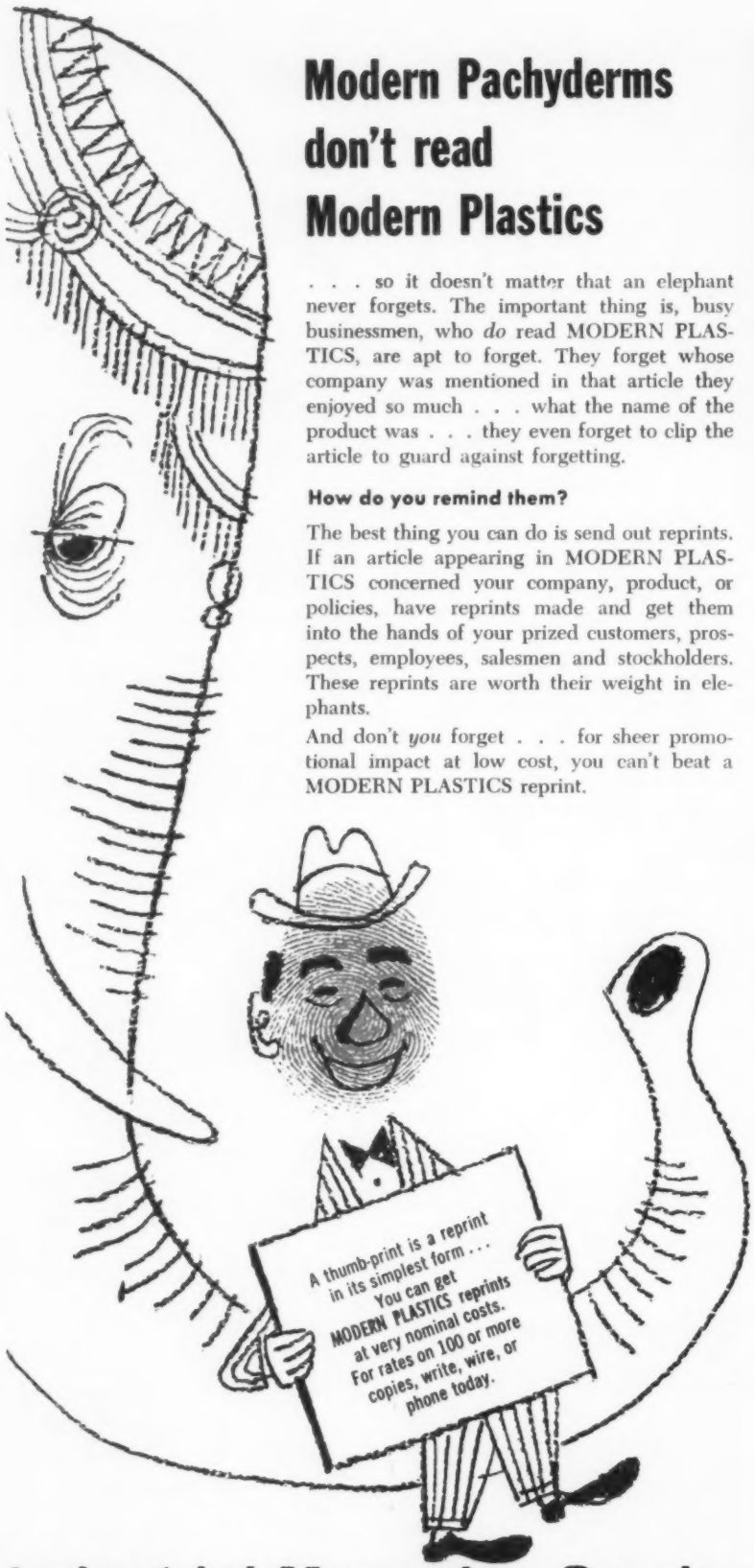
The ability to drill or machine this laminate with ease makes it possible to refasten chrome strips, door handles, and other detachable auto parts to repaired areas. Important savings in skilled labor man-hours and initial cost of materials and equipment can be achieved with similar repairs to trucks, buses, washing machines, and other appliances making use of sheet metal.

Fig. 1—Fibrous glass cloth is cut to fit area to be repaired (background)

Fig. 2—After epoxy-impregnated cloth has been laid up, heat is re-applied

Fig. 3—Cured area can be sanded down to conform to desired contour

CREDITS: Repair kit is packaged by Arndt-Palmer Laboratories, Melvindale, Mich., using epoxy resin supplied by Bakelite Co. and fibrous glass cloth supplied by Owens-Corning Fiberglas Corp.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. . . so it doesn't matter that an elephant never forgets. The important thing is, busy businessmen, who *do* read MODERN PLASTICS, are apt to forget. They forget whose company was mentioned in that article they enjoyed so much . . . what the name of the product was . . . they even forget to clip the article to guard against forgetting.

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**Cap, integral hinge, and body of polyethylene vial are molded in one piece**

## Polyethylene Vial

HINGED-ON cap permanently attached to the main body of the vial is the outstanding feature of this new molded polyethylene container. The body and lid are injection molded in one piece with a narrow strip of polyethylene uniting the two. This strip serves as a natural hinge for the cap, enabling the cap to be easily flipped open or snapped shut with one hand—and the hinge is tough enough to withstand thousands of openings and closings without failing. (See also "Molded Cases for Precision Packaging," p. 112 of this issue).

The one-piece polyethylene vials were originally created for use in the pharmaceutical industry but since their introduction have found numerous applications in packaging hardware goods, foods, seasonings, scientific instruments, precision tools, fishing supplies, and scores of other products.

In addition to the obvious advantages of the integral hinge, the vials are unbreakable, sanitary, and light in weight. Labels inserted in the container are plainly visible through the thin, transparent walls. If outside labeling is preferred, pressure-sensitive labels can be used.

The containers, known as Polyvials, are now being manufactured in four standard sizes, but this range is expected to be extended early in 1955.

CREDIT: Polyvials are a product of Olympic Plastics Co., Inc., Los Angeles, Calif.

for Lubricating and plasticizing action
- Easy processing
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for Improved wet strength
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**"Has cut high-impact polystyrene for a year without sharpening..."**

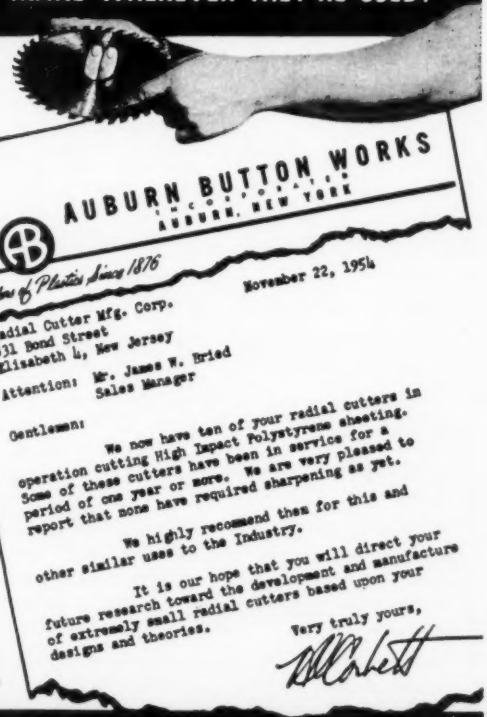
Herb Corbett, Chief Engineer, Auburn Button Works.

*This Saw Blade is Really Different!*

**Super-finishing** is one of the major differences between Radialloy Saws and ordinary carbide types. It is a costlier way to produce blades, but we have found that our customers prefer the higher performance and operating economies that result.

Plastics and plastic laminates are typical "tough sawing" materials, and poorly designed or poorly finished blades vibrate due to slight variations in tooth construction or finish, or unequal thermal relief. Not so for super-finished Radialloy saws! They're engineered from the heat-treated shank out as carbide blades, and are not just regular saws with carbide tips added. The slight extra cost pays off for you in that your blade runs cooler and cuts clean and true. There is no waste of material . . . and they last much, **much longer.**

Why don't you look into the **economies** of super-finished Radialloy saws? Find out, like most of America's leading manufacturers of plastics and laminates, just how **good** a saw blade can get!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November 22, 1954

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It is our hope that you will direct your future research toward the development and manufacture of extremely small radial cutters based upon your designs and theories.

Very truly yours,

W. Corbett

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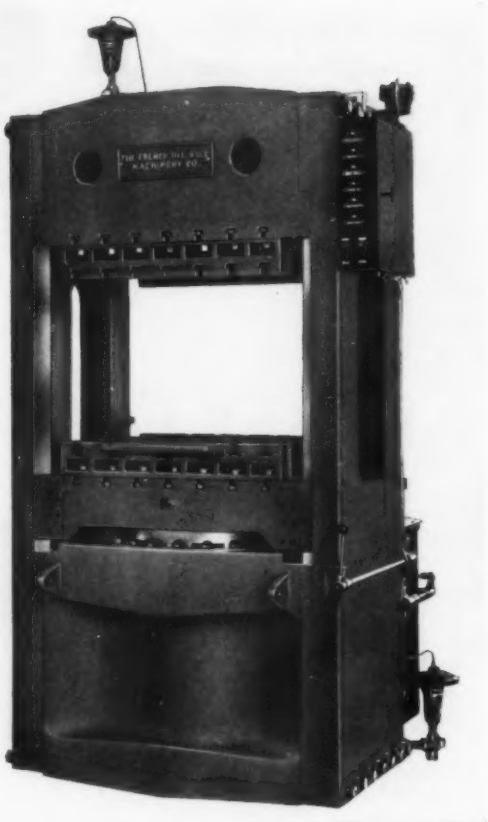

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## Chemical Feeder

THE introduction of a new precision liquid chemical feeder fabricated entirely from rigid, unplasticized vinyl reflects the increased usage of this material in the chemical industry. As a replacement for the stainless steel parts used in the old model, the vinyl components resist the corrosive effects of acids and chemicals fed through the reagent distributor more effectively than any metal possibly could. In addition to the chemical industry, the unit is finding use in the petroleum, mining, and food industries, and even for the feeding of chemicals into small swimming pools. It is also used for the pH control of industrial cooling towers.

Every part of the machine, with the exception of the motor and name plate, is molded or machined from rigid vinyl. These parts include the heavy shafting, float valve, all the mechanism, piping, screws, and nuts. The top cover is formed from transparent vinyl sheeting so that the liquid contents and mechanical workings can be observed.

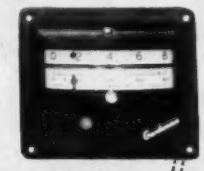
In addition to providing complete corrosion protection, the vinyl unit is more compactly designed and lighter in weight than the metal model and is marketed at a lower price. The entire machine weighs about 20 lb. and measures about 20 in. long, 14 in. high, and 12 in. wide.

CREDITS: The feeder is manufactured by The Clarkson Co., San Francisco, Calif. Vinyl parts are fabricated by K-Plastix, also of San Francisco, using Geon vinyl resin supplied by B. F. Goodrich Chemical Co.

Entire machine, with exception of motor and name plate, is made of vinyl




# Where ACCURACY in TEMPERATURE COUNTS!



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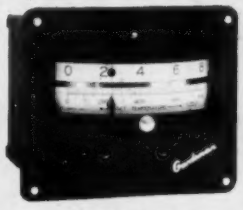

Model JP

Gardsman

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Write for data on complete line of pyrometric controllers and indicators—including On-Off, High Limit, Program and Multi-Switch Position—plus Thermocouples and Accessories for any controller.

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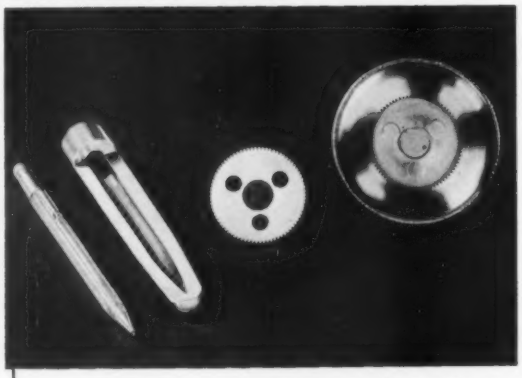
One master makes any number of cavities, each one *precisely uniform* in every detail. Masters last forever!



When there is a call for exceedingly deep cavities, for cavities which must reproduce exacting surface designs and textures, for a series of cavities which are *identical* . . . that's the time to call on Camin. From steel or other masters, Camin electroformed cavities reproduce *intricate shapes that can't be machined, can't be hobbed.* Supplied ready for installation in mold bases.

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CAMIN LABORATORIES, INC.
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Heat-sealed seams on vinyl jackets improve appearance, add to wearability

## Heat-Sealed Jackets

OUTERWEAR jackets and coats of supported or unsupported vinyl film are now being turned out on a mass-production basis through the use of dielectric sealing equipment.

According to the supplier of the high-frequency machines, conventional sewing techniques presented several difficulties when adapted to the manufacture of the vinyl jackets. Where the needle penetrated the film, for example, it was claimed that the material would tear.

By installing electronic sealing units, however, many of these difficulties were overcome. On a typical production line set up by a leading clothing manufacturer, each part of the jacket, such as sleeve, collar, pocket, buttonholes, etc., is sealed in a single operation. Each sealing process takes from one to two seconds and the seams on the finished product are not only completely waterproof, but have a life expectancy which is as long as that of the film itself.

The flexibility of the heat sealing technique is also evident in the styling of the jackets. Design innovations such as false pockets that double as belt loops are now economically practical in the low-priced garments.

In addition, because of the fact that unskilled labor can be substituted for the skilled labor needed to operate sewing machines, costs are substantially reduced.

CREDITS: Heat-sealing equipment supplied by Radio Receptor Co., Inc., New York, N. Y.; heat-sealed jackets by S. Buchsbaum Co., Chicago, Ill.

year without charge.

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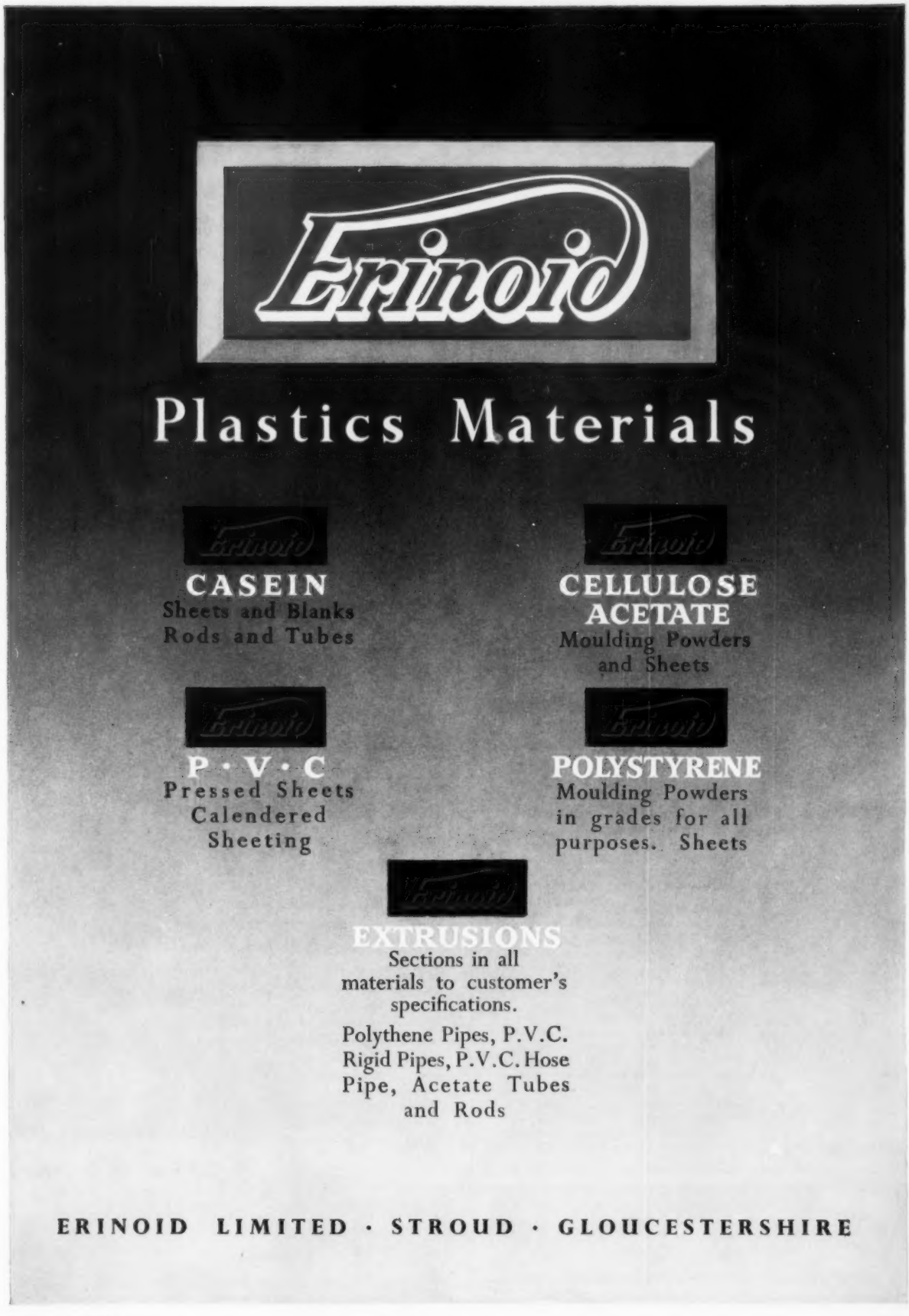

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From a cold start through a full production run, Sterlco's "fast service" and extremely high degree of sensitivity assure quick warm-up and accurate, automatic mold temperature control for faster production and minimum rejects.

*here's why . . .*

1. Super-fast 9000 watt unit on each side for quick starts
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3. Super-sensitive, accurate HEATING CONTROL with extremely fast reaction time.
4. Flexible, modulating COOLING CONTROL—not on or off.

MODEL 6003 — DUAL

MODEL 6002 — DUAL

The mobile temperature control unit functioning in leading plastics plants from coast to coast. Ready to operate when connected to electricity, water and drain.

MODEL 6012 — SINGLE

**MODEL 6003 — DUAL**
A compact unit designed for permanent installations. (Can be equipped with casters). Requires approximately 50% less floor space than Model 6002 with same capacities.

**MODEL 6012 — SINGLE**
A highly efficient unit for use where a single stabilized temperature is adequate as in small molds or molds with shallow cavities. Works well where metal molds provide for water circulation in vacuum forming, as well as to control temperatures of calender rolls in sheet extrusion. Can be used with above DUAL models where MORE than TWO temperatures are required.

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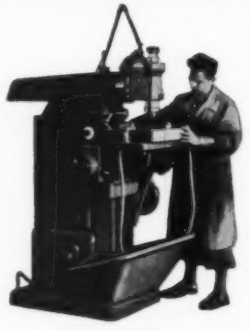
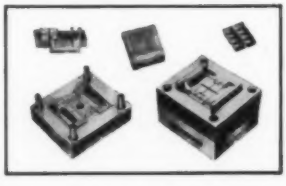


A modern plant . . . latest machinery . . . trained, experienced personnel . . . combine to furnish you dependable injection molds at extremely reasonable prices.

We are equipped to provide the most complicated molds of highest quality. Layouts are planned by experienced engineers to fit the latest requirements of American plastic manufacturers. Service is prompt. Write immediately for detailed information and prices.



Our own injection molding machine allows test samples to be shipped without delay for approval.

**SCHWARZFAERBER**

42 Geisseestrasse Nuernberg
Germany (U. S. Zone)

# Acrylic Headlight

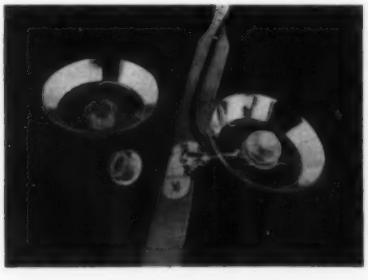
DESIGNERS of a new doctor's headlight for eye examinations have taken full advantage of the properties of acrylic to achieve an unusual combination of optical excellence, comfort—for both doctor and patient—durability, ease of adjustment and use, and economy.

The principal parts of the new instrument are a single-piece concave reflector and the lens which it encircles. Both are molded of acrylic. In addition, the back of the reflector is vacuum metallized with a scratch-resistant aluminum coating. The universal joint, by means of which these parts are connected to the headband, allows the headlight to be swung into any desired position in front of the doctor's face or on his forehead to provide optimum illumination for diagnostic purposes.

Thanks to the optical qualities of acrylic, light emanating from the entire 360 degree perimeter of the reflector, as well as from the bulb behind the lens, is diffused so that glare and specular reflection are absent. Under these conditions, the possibility of diagnostic error due to uneven light projection is greatly reduced. Nor, because of the insulating properties of acrylic, is any objectional heat transmitted from the bulb.

Despite the rugged protection which the acrylic components provide, weight is so negligible that the headlight can be worn by the physician with complete comfort—free from distractions. The headlight is supplied with a transformer for use with 110- to 120-v., 60-cycle alternating current.

CREDITS: The headlight is made by Welch Allyn, Inc., Skaneateles Falls, N. Y., using Plexiglas V-100 supplied by Rohm & Haas Co.



Acrylic lens and reflector for doctor's headlight insures even lighting


MARKEM SOLVED THIS MARKING PROBLEM

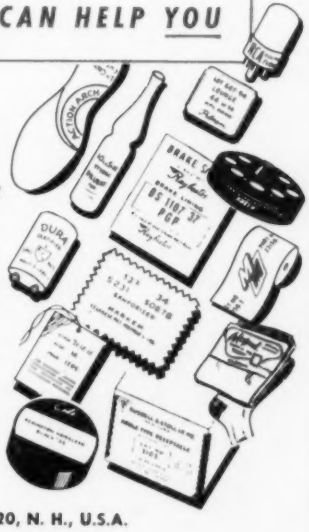
**IMPROVED PRODUCT APPEARANCE —LOWER PRODUCTION COSTS**

A manufacturer of wood screws increased his product's retail merchandising appeal by changing from cardboard boxes to plastic tube containers which clearly display the screws. He now prints all label data directly on the cylindrical container with a Markem machine. Quickly changed variables in imprints include: quantity, type of plating, head type, length and size. Containers are imprinted as and when needed; no inventory of marked containers need be maintained. The method eliminated outside printing changes, tremendous paper label inventories, and labor of label application. One Markem machine, printing at production rates in exact quantities, has made possible the more attractive and appealing package and at the same time reduced production costs appreciably.

THE MARKEM METHOD CAN HELP YOU

*This is just an example of how Markem solves industry's marking problems. The complete Markem Method consists of: (1) ANALYSIS of your marking or imprinting problems, (2) RECOMMENDATION of appropriate Markem Machine, Markem Type and Markem Ink, and (3) SERVICE – in installation, instruction, maintenance and supply.*

*If you want to mark products, parts or packages for identification, control or market, get in touch with Markem. The Markem Method has been providing a single source for savings in time, effort and inventory . . . since 1911.*



Markem Machine Company, Keene 20, N. H., U.S.A.

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PRODUCE

**25% MORE BEADS**

***and* BALLS *with***

**The ROYAL MASTER**

***Centerless Grinder***

Royal Master Centerless Grinders give you at least 25% more production than other types. You get more output per cycle because of the larger grinding wheel. You can grind, 21 8mm beads per cycle, with a .070" cut off (between each bead). Tolerances of ±.001" in diameter .001" in sphericity can be consistently held. You get more cycles per minute: 10 or more—depending on the type of material.

**You get more precision ground beads or balls because**

**1.** The outboard bearing supporting the grinding wheel assures spindle rigidity.

**2.** The work rest blade is supported at both ends.

**3.** The regulating wheel ram is actuated by pressure against its center. This "Centra-Pressure" principle permits, for the first time, even pressure all along the material to assure even grinding and beads of identical size.

Royal Master Centerless Grinders are compact. Model P.G. 7, occupies only 24" x 36" of floor space.

•

**Write for bulletin describing the P.G. 7 and other Royal Master Centerless Grinders.**

**ROYAL MASTER, INC.**

**250 State Highway 23, Riverdale, N. J.**

# Junior Giant

(*From pp. 87-97*)

the counters of variety stores, supermarkets, and hardware stores.

Sheet forming techniques make available to the packager a number of methods for encasing the card in a crystal-clear, tough, moistureproof plastic sheath that offers maximum visibility and also protects the carded merchandise.

One of these methods involves the use of a transparent plastic bubble, either hemispherically shaped or formed to the exact contours of the carded item. When packaging the item, the unit is first positioned on a preprinted die-cut card. It is then covered with the plastic bubble which is, in turn, fastened to the card by stapling, gluing, heat sealing, or by imprisoning the flange of the bubble between two separate cards and then gluing the cards together.

Bubble packaging has already been successfully used on a number of items. Fabri-Kal Corp., Kalamazoo, Mich., for example, has developed a bubble package for a carded fountain pen, while Mankato Paper Box Co., Mankato, Minn., uses the method to pack a large chain wrench.

A variation on the bubble package is used by Hernard Mfg. Co., Inc., Yonkers, N. Y., for a set of five toothbrushes. A sheet of clear 0.010-gage acetate is first formed in a 75-cavity mold, yielding 15 complete packages per cycle. The toothbrushes are then inserted in this transparent contoured cover and the cover is heat sealed to a backing sheet.

Logical follow-up to bubble packaging is the new "skin" package. Champion Hardware Co., Geneva, Ohio, is one of the companies that has adopted this technique and is using it to package 21 different kinds of hardware. Champion first prints a number of cards on a single sheet and coats them with a thermoplastic resin adhesive. Each card is then perforated so that positioning pins may be extended through the card to provide pockets for separate small parts such as screws. Holes are also cut into the card to provide for various odd-shaped parts of the merchandise. These openings, incidentally, double as vacuum holes.

After the items have been loaded on the cards, the transparent butyrate or acetate sheet is clamped in place, heated, and pulled down skin-tight around the hardware parts. The forming operation also simultaneously laminates the sheet to the exposed surfaces of the card.

The result is an almost invisible package that: 1) holds the parts rigidly in place so that they cannot rattle around; 2) cannot crease or be crushed by handling or in shipment; 3) takes up less room; and 4) offers greater consumer eye appeal. Since sheet thickness can be as low as 2 to 5 mils, material costs can be kept low. In addition, there are no tooling or mold costs, and as soon as the cards have been die-cut out of the sheet no further assembly operations are available.

"Skin" packaging is also being used for applications other than carded merchandise. As an example, Tico Plastics, New York, N. Y., forms a sheet of acetate around a group of toy plastic figurines being marketed by Multiple Products Corp., New York, N. Y. The skin-tight sheath locks the toys tightly in place and provides an attractive, virtually invisible package.

**2) Contoured Packages and Platforms**—Contoured packages differ from bubble packages in that two separate plastics sheets are formed to the shape of the back and front of the item to be packaged and hinged together to form the completed unit.

One variation of the contoured package is a container for fuses developed by Linsley, Inc., Westport, Conn., for Zell Electric Mfg., New York, N. Y., and formed by Watertown Mfg. Co., Vacumatic Div., Watertown, Conn. Originally, the package was a cardboard box with a scored opening through which the fuses could be removed. Zell, however, felt that it would be more convenient to package fuses in a container that could be hung near the fuse box or directly on the wire pull handle of the fuse box within easy reach of the user.

The formed high-impact styrene container was the perfect answer. It is designed with four cup-like depressions into which the fuses fit. The depressions are tapered so that the fuses can be easily press-fit in and just as easily pulled out. A hook is die-cut into one end of the styrene sheet and a hole is die-cut into the other end when the piece is profiled. Production rate on the fuse

box package is expected to reach 20,000 a day and volume can be increased still further as more cavities are added to each mold.

**3) Food Packages**—Big volume is predicted for formed packages in the food field once this application gets on its feet. The low individual unit cost of small formed containers run off continuously in super-large quantities seems especially suited to the manufacture of single-portion packages for jams, cream, etc.

Advances in pressure and vacuum forming techniques permit economical fabrication of snap-in or snap-over lids for various types of food containers. A transparent cover-all lid for paper food containers is being formed from 10-mil oriented styrene sheeting for use by Dixie Cup Co. on 8-, 12-, and 16-oz. containers. The cover-all forms a primary seal with the cup's bead and has an overlap for the brim, providing a completely sanitary seal.

Another innovation in food packaging that is creating a considerable stir in packaging circles in this country, is a formed polyethylene container originated in Canada. The deep square lower half of the package is formed of 20-mil polyethylene and sealed with a lid of polyethylene coated cellophane. The rugged unit, developed by Samuel Fogel Packaging and Display Consultants, Montreal, and formed by American Paper Box Co., Ltd., also of Montreal, is being used by Crescent Cheese Co., Montreal, for packaging cheese. It has possibilities, however, for the packaging of delicatessen, fresh shrimp, liver, and similar perishables. There has even been talk of supplying the containers as stock items to supermarkets, allowing them to do their own prepackaging.

Because the container is formed of thin gage polyethylene, it is claimed to be competitive in cost with other packaging media, such as glass, cardboard, and fibreboard. Once the unit is in volume production, it is further stated that the price will be 30% cheaper than molded containers.

**4) Novelty Packages**—The versatility in design inherent in sheet forming has also opened new areas of application in novelty packaging.

Pro-phy-lac-tic Brush Co., Florence, Mass., for example, designed a fleet of formed acetate ship model packages for children's toothbrushes. Each container—there are three to a

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You are cordially invited to visit our new modern molding plant
MINNESOTA PLASTICS CORP., 45 E. MARYLAND AVE., ST. PAUL 3, MINN.
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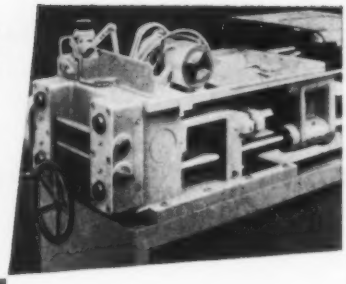
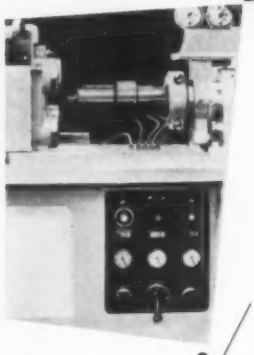


Automatic return of injection unit



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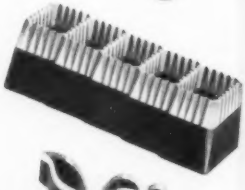

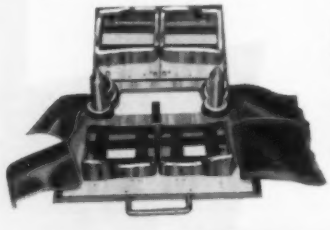

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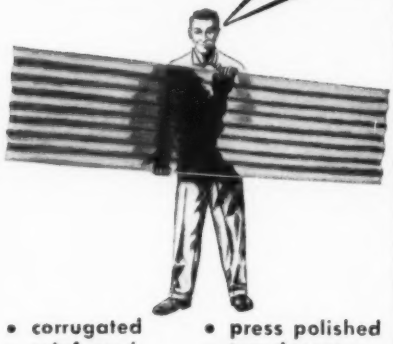

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Sizes to 51″ x 108″

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*Smooth* flaw-free surfaces. Good optical properties when transparent

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display card—consists of a transparent top and a colored opaque bottom or hull and holds one toothbrush.

Another unusual type of double-purpose novelty package has been designed by Trimfoot Co., Farmington, Mo., for packaging baby shoes. The top of this package is pressure formed by Plaxall, Inc., Long Island City, N. Y., of transparent acetate; the flat base is vacuum formed of vinyl. The underside of the base has a three-dimensional Walt Disney design four-color preprinted in distortion and formed into register. After purchase, the base can be removed and hung on the nursery wall.

Other sheet formed packaging developments include a compartmented acetate pack for bearings in which the cavities are filled with oil and locked in place with a flat sheet of acetate heat sealed to the top; an acetate silverware tray formed to shape and then flocked; and a three-unit transparent bubble for cigars.

## Signs and Displays

Signs and displays have one basic function: to attract attention. By taking advantage of the design-potential inherent in sheet forming, the manufacturers of such advertising specialties are achieving virtually "eye-popping" effects. Last year's displays truly merited descriptions as "spectaculars," but this year's crop is even bigger, more colorful, and more spectacular.

Even a random selection of some of the year's highlights should include the following:

1) Timely Products Mfg. Co., Des Moines, Iowa, has developed a combination pressure-vacuum forming technique for the production of signs with outstanding clarity and color registration. Base colors, background panel colors, and woodgrains are first preprinted on the sheet. If there is no need for close register of color, the sheets are heated to forming temperature on a heat-controlled plate and then fed over the mold. If register of color is important, the plastic sheet is locked in a frame and then registered over the dies before pressure is applied. Fast-closing hydraulic cam action, or air pressure presses are used. Final coloring is applied by spray-painting through electroplated stencils and all lettering and raised design that is flat is top printed.

2) Stanley Wessel & Co., Chicago,

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For cementing cellulose acetate . . . safer and better . . .
**ACETITE**
No acetone. Non-inflammable.

For bonding plastics to plastics and plastics to non-plastics . . .
**REZ-N-GLUE**
For cementing styrofoam.

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Sets instantly. Ready for finishing operations within an hour.

For cementing all flexible vinyls.
**VC-2**
Or the lighter grade VC-1 . . . depending on your needs.

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FILLING THE NEEDS OF THE PLASTIC INDUSTRY
For descriptive literature write
Schwartz CHEMICAL CO., INC.
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Ill., has added a distinctive new twist to the formed display field. Two displays recently produced by the company both use an actual four-color photograph, instead of art work. Slightly distorted and then formed into register, the over-all effect of the photographic display is one of extreme realism.

3) The Valley-National Corp., Milldale, Conn., has successfully applied the bubble packaging technique to the design of an unusual type of display for General Electric Co. A sheet of 0.080-in. high-impact styrene is first formed to the back contours of cords, plugs, switches, etc. A sheet of transparent 20-gage acetate is then formed to the contours of the fronts of each item. The items are then dropped into place in the styrene sheet and the transparent contoured acetate sheet is fastened to the front of the display.

4) Western Plastics Corp., Tacoma, Wash., has designed an attractive hardware display for Washington Steel Products, Inc. The four side panels of the box-like structure are formed of 0.040-in. black modified high-impact styrene in a female aluminum mold. The flashing is then blanked off and holes for the hardware are punched out. The display was made at ⅛ the cost of a wood model that had been originally proposed, and proved considerably more attractive.

5) A pen display by Imperial Industries, Inc., Wayne, Mich., utilizes two plastics materials and two forming techniques. The top clear half of the display is formed of acrylic by the plug and ring technique. The tray which holds the pens is vacuum formed of high-impact styrene and is flocked to resemble velvet.

## Decorative Materials

A major contribution which the display field has made to the sheet forming industry has been a basic emphasis on decorative materials and preprinting techniques. Most of today's refinements in the preprinting technique grew out of activity in this field by display manufacturers. Similarly, metallized acetate and butyrate sheets were among the first of the decorative materials to be adopted by display manufacturers and have since found wide use in various industrial applications. Metallic appearance opens especially lucrative opportunities for display makers for jobs in which appliances or cutlery have to be simulated.

One such job has been done for International Silver Co. by Chanal Plastics Corp., Brooklyn, N. Y. Using silver-metallized butyrate sheet, a 5 ft. high replica of a spoon was formed in two halves which were cemented together. A wire skeleton frame between the two halves lends added support and rigidity. Originally, it was planned to simply cement this frame in place, but assembly proved a difficult job. Chanal Plastics, therefore, inserted platform rests in the mold for the back half of the spoon and placed the skeleton frame on top of these rests. A thin-gage sheet of clear butyrate was then formed around the frame. Assembly was thus simplified by cementing the butyrate-covered frame directly to the inside of the back half before joining the two halves together. This type of assembly also prevents the frame from rattling around inside the hollow spoon.

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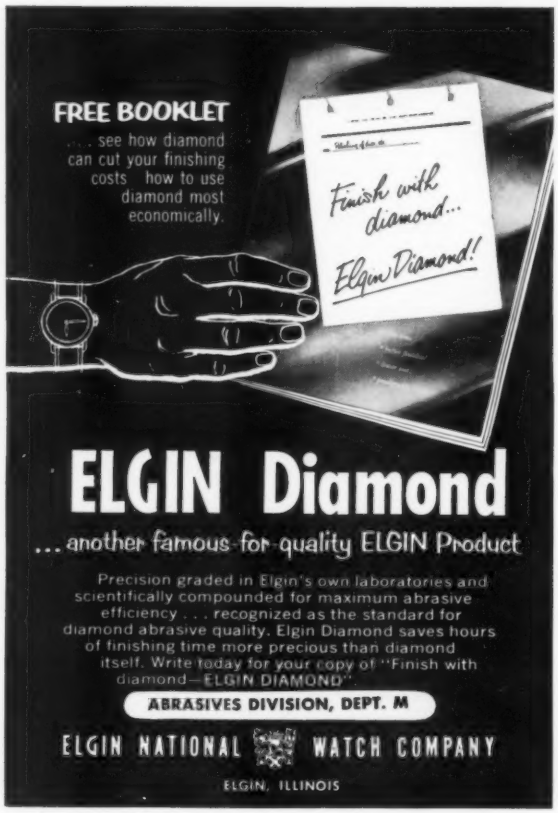
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"Mechanically, the presses have left nothing to be desired. Their rigidity maintains precise dimensions and tolerances. Mechanical failures are practically unheard of. For example, in nearly ten years of continuous operation, we have never once had occasion to replace the packing in the rams."

Impressive as it is, this Elmes "case history" is simply typical of the experience of plastics molders the nation over. For details on Elmes Hydraulic Molding Presses see your Elmes Distributor, or write us direct.

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thermoplastic sheeting prior to forming is the use of decals. Chanal Plastics has developed one application in which a wood grain finish is applied by the decal method to a sheet of high-impact styrene that is then formed into a display. The company is also working on applying a marble grain finish to a sheet of high-impact styrene and then forming the sheet directly over a sculptured plaster block. A formed product of this type could serve as a sturdy and attractive base for trophies or desk pen sets.

### Refrigerator Parts

The impact of sheet forming in the refrigerator industry has been far greater than anyone anticipated. The formed door liner has virtually obsoleted liners made by pressure laminating, metal stamping, or injection molding.

From Philco Corp., Philadelphia, Pa., comes the following report on the use of sheet forming techniques:

"In 1954, Philco used 20,000 formed inner door liners, weighing about 5 lb. apiece; in 1955, Philco intends to use about 100,000 door liners, in addition to 30,000 cover plates, weighing one lb. apiece, and 175,000 drain baffles at ½ lb. apiece.

"While 1956 projections are not set, Philco will probably be using double to triple the number of formed parts."

Nearly every other manufacturer reports a similar growth pattern in the use of formed parts. So important has the process become that many leading appliance manufacturers have already installed forming equipment as part of a continuous assembly-line procedure operating continuously 'round-the-clock.

### Housings

The acceptance of formed sheet components by the refrigerator industry, coupled with the introduction of the extra-tough styrene alloys and copolymers, has led to consideration of formed sheets for other appliances. Philco Corp. already turns out about 10,000 air conditioner front panels weighing 2½ lb. apiece annually, and formed styrene housings are being considered for vacuum cleaners, washing machines, and similar appliances.

In industries other than the appliance field, formed sheet housings are finding popular appeal. A job be-

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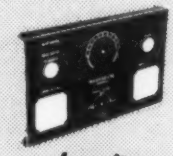
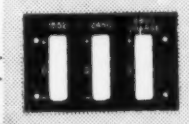
bend it



form it



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10,000 Engravographs in use for engraving on metals and plastics. Only the Engravograph has these patented features:

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Engravograph Booklet IM-20 • Gravoflex Booklet G-20

NEW HERMES ENGRAVING MACHINE CORP.
13-19 UNIVERSITY PLACE, NEW YORK 3, N. Y.

ing done by Regal Plastic Co., Kansas City, Mo., illustrates one trick employed to overcome excessive thinning in a deep-draw piece. The part is a housing being supplied to Bell & Howell Co., Chicago, Ill., for use in a microfilm viewing machine. This particular housing is formed out of 3/16-in. grained styrene copolymer sheet and is approximately 20 in. deep, 12 in. wide, and 12 in. high. The part is formed with a decided undercut to form the bezel around the reader housing ground-glass plate that is subsequently inserted behind the bezel. After trying various reinforcements to strengthen the thinned-out areas in the bezel section, Regal came up with the idea of pouring foamed-in-place liquid isocyanate foam into the groove around the entire periphery of the bezel. After it has foamed, the isocyanate becomes a rugged, void-filling bead.

A big boost in promoting plastics sheet in the housings field is the growing use of sheet coverings formed directly over a product which, in effect, serves as a male mold. Sheet plastic can thus be applied over metal business machine housings, appliance housings, etc.

One variation on this method has recently been developed and is already showing great promise. In cases where the end product is a solid unit, such as trophy or pen set bases, dispensers, etc., an inexpensive cast plaster piece is placed on the bed of the machine and the sheet vacuum drawn around it. After the plaster piece in its attractive, protective plastic sheath is removed from the vacuum forming machine and trimmed, it is ready for use.

An example of the potential inherent in this method is a tape dispenser unit currently being developed by Nordic Plastics, Brooklyn, N. Y. The dispenser is made of plaster and a high-impact styrene sheet is formed around it. The unit measures 9½ in. long and has a draw of about 5 inches.

### Toys and Novelties

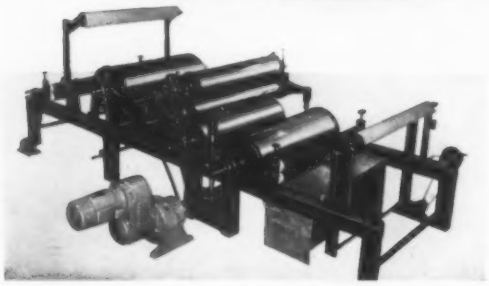
Practically the entire output of the early vacuum forming machines was devoted to toys and novelties. Most of these products were in the "gimmick" category, however, noted more for their novelty appeal than for anything else.

Today, major emphasis on sheet forming in this field has switched to solid, well designed, and soundly engineered products. The Toy Fair this year is expected to see the introduction of several unusual formed toys; one major material supplier is planning to start promotion on a revolutionary type of mobile toy which will consist of vacuum formed parts cemented together.

A number of the toys introduced this year, which depend to a great extent upon formed parts, are briefly described in the following paragraphs.

**1) "Flying Superman"** introduced by Transogram Co., New York, N. Y. The main component is a figure of Superman formed in two halves of styrene sheet and cemented together. To use the toy, one end of a rubber band is attached to the figure and the other end to a handle. When the rubber is stretched and then released, the figure shoots into the air and then glides to earth. By using sheet forming techniques, the wall sections are thin and light enough to

**Liberty Embossers offer these 9 advantages**



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**—Finish Circular Moldings AUTOMATICALLY With This Performance-Proven NASH 103-B Flash Lathe . . .**

In molding circular plastic parts, you are faced with fixed costs for overhead, materials, time of molding cycle. But you can make substantial savings when it comes to *finishing* — if you perform this operation AUTOMATICALLY — the *NASH* way.

**This Is The Machine That Does It...** the dependable, fast-operating NASH No. 103-B Automatic Flash Lathe.

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Saves Hours Of Production Time

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**J. M. NASH Company**

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permit the unit to glide through the air.

**2) Formed vinyl face masks** for a paint-it-yourself mask set by Raleigh Enterprises, Inc. New York, N. Y. In addition to the masks, the kit contains water colors and brushes plus a plastic clay.

**3) Motor-powered models**—one a model of a speedboat fabricated by Glidden Coating Co., Pitman, N. J., for Sterling Models, Philadelphia, Pa., and the other a model of an airplane, by L. M. Cox Mfg. Co., Santa Ana, Calif. Both units are assembled by cementing together two detailed halves formed of high-impact styrene. Again, the adaptability of sheet forming to the production of thin, yet rugged, wall sections plays a major role in both applications.

**4) Toy Town** set by Duraplastics, Inc., Bridgeport, Conn. This set consists of a sheet of plastic, preprinted and then formed to represent a miniature town complete with three-dimensional buildings. Also supplied with the town are three pairs of plastic cars formed around a magnet. One of the cars in the pair can be placed on the road that runs through the town and its movement controlled by placing the second car upside down directly beneath it.

**5) "Doodle Desk"** tray by Eldon Mfg. Co., Los Angeles, Calif. The tray is formed of white styrene copolymer sheet preprinted by silk screening on both sides. The desk is 17⅛ in. square. The child can write with crayons on the surface. Wells are formed into the back ledge for sponges that can be used to clean off the crayons and leave the face blank. When it is turned over, the desk becomes transformed into a convenient spill-proof bed tray.

**6) An electric toy train set** fabricated by Nordic Plastics, Brooklyn, N. Y. for Toyland World, New York, N. Y. The trains themselves are made of wood, but the cab which houses the electric motor and the case which houses the batteries are both fabricated of high-impact styrene.

One of the first applications of forming in the novelty field, the production of toy derby hats and firehats, has given birth to the manufacture of various types of practical headgear. A set of durable rigid caps for outdoor use is now being formed of butyrate sheet by Eldon Mfg. Co.,

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**Holder of the United States and Foreign Patents on Suction* Forming of sheet thermo plastics**

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World's oldest manufacturers of suction* forming equipment . . . drape, cavity, plug, embossing, skin-pack.

Builders of machines to meet your individual needs.

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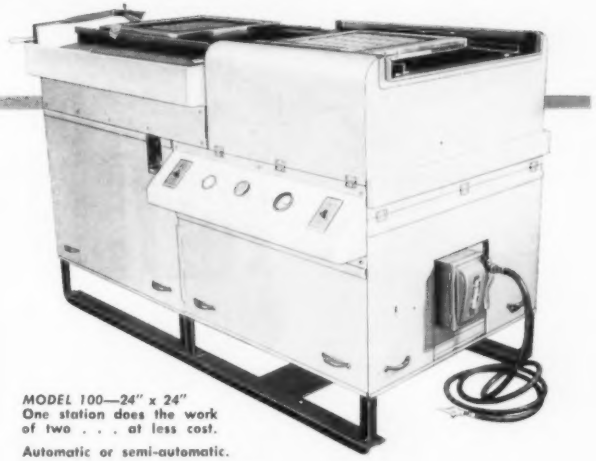
For speed, quality, versatility and uniformity, insist on a Borkland.



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One station does the work of two . . . at less cost.

Automatic or semi-automatic.

Self-contained 9-inch draw or less. Flexible, accurate, easy to operate.

OTHER MACHINES . . . 24" x 60"—36" x 108"
Fully automatic or semi-automatic.

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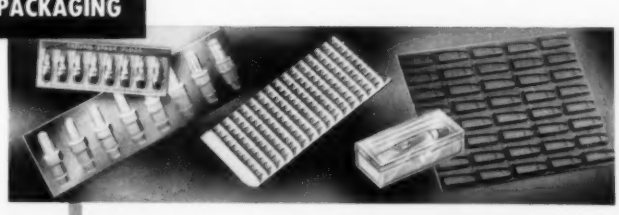
Leader in Suction* forming for 10 years. Finest equipment for Suction* forming, drape, plug, embossing.

Ten presses . . . automatic, semi-automatic and manual.

Electronic sealing, die-cutting and assembly line production equipment.

**DISPLAYS**

**PACKAGING**



**INDUSTRIAL AND NOVELTY**

*Suction Forming . . . commonly called "vacuum forming" erroneously.

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**WESTCHESTER PLASTICS, INC.**

**326 Waverly Avenue, Mamaroneck, New York**

Los Angeles, Calif. The hats are formed with peaks in front to shade the eyes from sun and glare.

### Housewares

In the housewares field, formed products are moving at an accelerated pace, but have not as yet achieved the large volume that had been predicted for them.

Perhaps the developments in adapting continuous forming techniques to the production of housewares items may be the catalyst that will set the application going. Nalle Plastics, Inc., Austin, Texas, for example, has developed just such a technique and claims that it gives a competitive edge in the production of low-cost products. All the forming of containers and trays is done automatically off the end of a 4½ in. extruder.

### Specialized Applications

It is almost impossible to break down vacuum formed applications into broad general market areas. There are so many individual specialized applications for sheet forming that a list of all would require volumes.

One such highly specialized application, a yarn guide being fabricated by Gladwin Plastics, Atlanta, Ga., illustrates the diversity of the technique. These guides are used in the textile industry for handling slivers, the first stage of twisting yarn, and were originally fabricated of separate pieces. This construction necessitated joints which would catch the fibers as they passed over the guide until they built up into a wad and interfered with the smooth flow of the yarn. By using the vacuum forming technique, the guides are now made from styrene copolymer sheet in one piece. Sheet thickness is 0.125 in. and some 25 to 30 separate forms at a time are produced on a 30 by 50 in. sheet. Assist frames are used to insure even distribution of the material.

Another application attracting attention as a possible forerunner to a complete new line of formed consumer products is a diaper can formed out of 0.080-in. high-impact styrene sheet. The body of the can is formed by Regal Plastic Co., Kansas City, Mo., in two halves and welded together. Its dimensions are 10½ in. in width, 13½ in. in length, and 23 in. in depth. A convenient compart-

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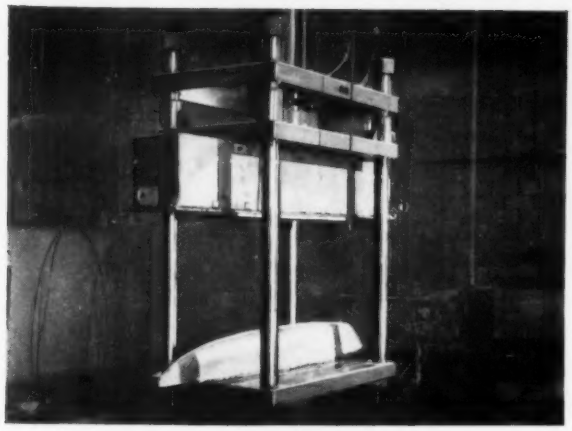

*Photos courtesy Narmco Mfg. Co., San Diego, Cal.*

Typical glass laminated part produced from sprayed metal tooling in press shown. Match molds for this jet aircraft wing tip were built up with alternating layers of sprayed aluminum and bronze over sprayed zinc base and backed with copper tubing, reinforced and insulated with laminated glass cloth. Tubing carries steam for cure, after which cold water is used to chill male for next layup.

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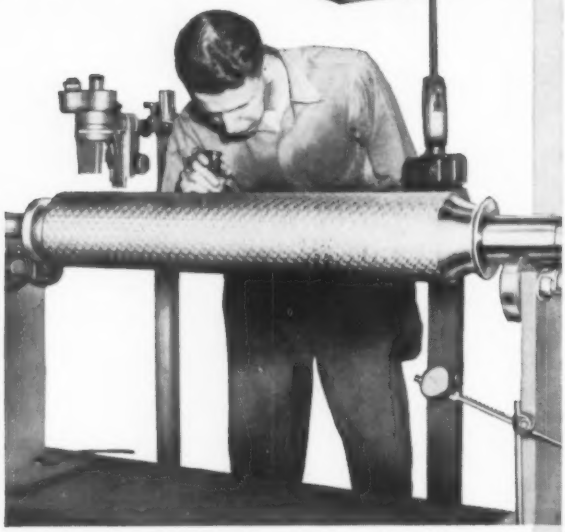

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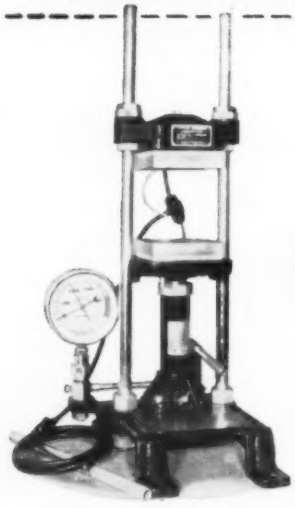

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ment for a deoderizing cake is also formed of high-impact sheet and cemented to the inside of the can cover.

Still another unusual formed application is a housing for a signal light inserted over a bulb in front of patients' rooms in hospitals. The housing is fabricated by Nordic Plastics of 0.080-in. thick white translucent butyrate . . . and still another application is an attractive lampshade formed of acetate sheeting by William F. B. Johnson, Philadelphia, Pa., to get a sculptured 3-dimensional effect . . . and the list of applications goes on . . . and on.

### The Future

In an industry in which new landmarks appear within a matter of months, the future is difficult to predict. Many successful applications and developments of sheet forming discussed in this article were only "blue-sky" thinking 12 months ago.

Despite all the progress being made, however, and all the publicity that the new techniques are receiving, sheet forming stands out as a means of complementing, rather than competing with, conventional processes by broadening the range of plastics products that can be fabricated economically and efficiently. Many molders and fabricators have already added sheet forming processes to their other methods in order to offer more diversified service to their customers . . . and the low investment for forming equipment has prompted a number of manufacturers who had never before used plastics to enter the sheet forming field.

### Acknowledgments and Credits

The editors of MODERN PLASTICS wish to thank the following companies for supplying information used in the preparation of this article: **Machinery manufacturers**—Auto-Vac Co., Fairfield, Conn.; Vacuum Forming Corp., Port Washington, N. Y. **Materials suppliers**—American Agile Corp., Bedford, Ohio; Bakelite Co., New York, N. Y.; Bolta Co., Lawrence, Mass.; Celanese Corp. of America, New York, N. Y.; Chicago Molded Products Corp., Chicago, Ill.; Coating Products, Engelwood, N. J.; The Dow Chemical Co., Midland, Mich.; E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.; Eastman Chemical Products, Inc., Kingsport, Tenn.; B. F. Goodrich Chemical Co., Cleveland, Ohio; The Goodyear Tire & Rubber Co., Inc., Akron, Ohio; Marblette Corp., Long Island City, N. Y.; Marbon Chemical, Div. Borg-Warner Corp., Gary, Ind.; Monsanto Chemical Co., Springfield, Mass.; Plax Corp., Hartford, Conn.; Rohm & Haas Co., Philadelphia, Pa.; and United States Rubber Co., New York, N. Y. **Suppliers of accessory products and equipment for sheet forming**—Cutting Die Institute, St. Louis, Mo; Herbert Products, Inc., Woodhaven, N. Y.; Logo, Inc., Chicago, Ill.; and Taber Instrument Corp., North Tonawanda, N. Y.

The following companies produce machines for vacuum forming: Abbott Plastic Machine Corp., Chicago, Ill.; Auto-Vac Co., Fairfield, Conn.; Comet Industries, Franklin Park, Ill.; Hydro-Chemie Ltd., Zurich, Switzerland; Industrial Radiant Heat Corp., Gladstone, N. J.; Radiant Heat Corp., Providence, R. I.; Tamco Industries, Inc., Huntington Station, N. Y.; Thermomat, Inc., Newark, N. J.; Vacuum Forming Corp., Port Washington, N. Y.; and Zack Industries, Passaic, N. J.

For a complete list of companies supplying material used in vacuum and/or pressure forming, see the Directory Section of the MODERN PLASTICS Encylopedia issue, Sept. 1954, as well as the MODERN PLASTICS chart of Vacuum Formable Rigid Thermoplastics Sheets which was published as an insert in the May 1954 issue.

The products of a number of custom fabricators are described in the foregoing article. Other companies who helped in the preparation of this article include: Celomat Corp., New York, N. Y.; The Emeloid Co., Hillside, N. J.; Fersons Industries Corp., New York, N. Y.; Klise Mfg. Co., Grand Rapids, Mich.; Plasticrafts, Inc., Denver, Colo.; St. Regis Paper Co., Panelyte Div., New York, N. Y.; Shaw-Randall Co., Inc., Pawtucket, R. I.; Shoe Form Co., Inc., Auburn, N. Y.; and Vacuum Molding, Inc., Boonton, N. J.

For a complete list of companies engaged in this work, in addition to those listed above and in the article, see the Directory Section of the MODERN PLASTICS Encyclopedia issue, Sept. 1954, and the article "Shape a Sheet," MODERN PLASTICS, *31*, 87, May 1954.—END.

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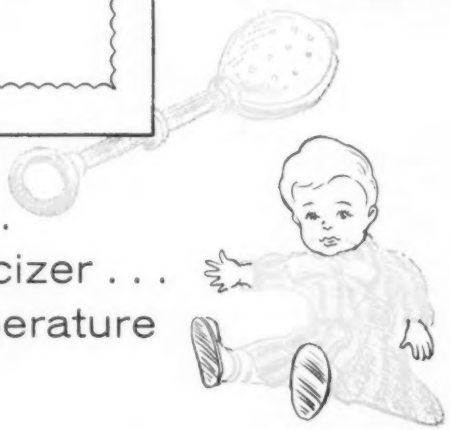

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**HEAT EXCHANGER.** Bulletin describes operation of heat exchanger used for controlled temperature cooling of water, oil and other liquids and gases employed in hydraulic presses, molds and extruders. Niagara Blower Company. **(D-502)**

**EXTRUDING EQUIPMENT.** Data sheets cover line of equipment used in the extrusion process and gives details on sheeting die, sheeting haul-off, pipe die, pipe pull-off unit, conveyor, etc. Robbins Plastic Machinery Corp. **(D-503)**

**RESIN.** Technical information on "Dapon," a resin that serves as a cross-linking agent for low-shrink polyesters, and in the formulation of plastics molding powders. Ohio-Apex Division, Food Machinery & Chemical Corp. **(D-504)**

**INJECTION MOLDING MACHINES.** Folder contains specification sheet prepared to aid in the selection of injection molding equipment. Covers five machines with capacities ranging from four to forty-eight ounces. Lester-Phoenix, Inc. **(D-505)**

**HORIZONTAL HYDRAULIC PELLETERS.** Bulletin describes three models of pelleters capable of turning out plastics pellets in eleven sizes, ranging from one half inch to four and one half inches in diameter. Sequence of operation is given in schematic drawing. B.I.P. Engineering Ltd. **(D-506)**

**COLOR COMPARATOR.** Details on equipment developed for scientific reproduction of "natural daylight" or "true North Light" to permit accurate color matching twenty-four hours a day in any weather. Gives construction and operating features of the unit which makes possible human-eye detection of color variations. Crown Engineering and Sales Company. **(D-507)**

**POLYETHYLENE OVERPRINT VARNISH.** Technical data sheet describes "Arcco C 602," a solution-coating designed to deposit flexible and abrasion-resistant films on printed polyethylene surfaces. American Resinous Chemicals Corporation **(D-508)**

**STOCK CUTTING MACHINERY.** Information on machinery for cutting and shredding cellulose, acetate, Bakelite and other plastics prior to further processing. Describes dicing cutter on which pellets are cut from sheet stock. Taylor, Stiles & Co. **(D-509)**

**VINYL PLASTISOLS.** Details on "Miccrosol," a vinyl plastisol whose exceptional film forming properties permit coatings of from .002 inches to several inches in thickness with one application. Michigan Chrome and Chemical Company. **(D-510)**

**SHEET PLASTIC FABRICATING MACHINES.** Folder shows a line of equipment for folding, creasing, beading, and drawing thermoplastic sheet material in gauges from .005 inches to .020 inches. Sketches reveal many fabricating techniques. Taber Instrument Corp. **(D-511)**

**POLYMETHOXY ACETALS.** Technical report covers properties and toxicity data on polymethoxy acetals which may be used as modifiers for phenolics, urea, melamine and polyvinyl alcohol; as a plasticizer; or in the shell molding process. General Aniline & Film Corp. **(D-512)**

**POLYVINYL CHLORIDE.** Twelve-page booklet covers "Seilon," an unplasticized polyvinyl chloride. Complete description and fabricating techniques, including machining, molding, and joining, are given. Seiberling Rubber Co. **(D-513)**

**MOLDED FIBERGLASS.** Brochure gives advantages and properties of fiberglass reinforced plastics. Shows in photographs six steps in the production of a typical product and outlines the facilities available at Molded Fiberglass Co. **(D-514)**

**ELECTRIC POWER DRIVES.** Catalog on line of electric power drives designed for a wide variety of industrial uses. Detailed specifications and cut-away drawings show methods of operation. Sterling Electric Motors. **(D-515)**

**REPAIRING REINFORCED PLASTICS PARTS.** Manual gives repair compounds, suggested repair kit, and step-by-step methods for repairing glass-reinforced plastic car bodies, boats, etc. Naugatuck Chemical, Division of United States Rubber Co. **(D-516)**

**LABORATORY PRESS.** Catalog covers a line of hand-operated hydraulic presses for research, pressing and developmental work in plastics molding and hot pressing, laminating, bonding, etc. Fred S. Carver Inc. **(D-517)**

**LIQUID CHILLER.** Details on the "Dry-Ex" direct expansion liquid chiller unit which is applicable for cooling plastic molds as well as in many other operations where effective heat transfer is vital. Acme Industries, Inc. **(D-518)**

**PAINT SPRAYING EQUIPMENT.** Catalog covers a wide variety of items, including spray guns, feed cups, hose, spray booths and other accessories used in spray painting. The DeVilbiss Co. **(D-519)**

**"PLASKON."** Information on two urea and melamine molding compounds made in pure white and a wide range of colors. Special features and recommended applications are included as well as detailed molding properties. Barrett Division, Allied Chemical & Dye Corp. **(D-520)**

**INDUSTRIAL OVENS.** Report covers design of industrial ovens with special consideration given to safety. Discusses ovens used in continuous extrusion coating systems, impregnation systems, and curing and polymerizing. Industrial Ovens, Inc. **(D-521)**

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**EXTRUSION CUTTER.** Details on a precision cutter for cutting extruded tubing or shapes to exact length. Unit is described as capable of cutting up to 7000 pieces per minute in lengths from 1/32" and diameters up to 1". Foster & Allen, Inc. (D-523)

**COLOR CHART.** Chart contains many samples of inorganic colors which are specially made for dry mixing with such plastics materials as polyvinyl chloride, melamine, polystyrene, etc. Ferro Corp. (D-524)

**INTERFERENCE SUPPRESSION FILTERS.** Catalog reviews company's standard line of interference suppression filters for use in screen rooms, induction heating equipment and similar equipment which may produce radio interference. Filtron Company, Inc. (D-525)

**PRIMER FOR PHENOLICS.** Technical bulletin discusses a phenolic-base primer for application to phenolic resin molded parts in order to provide a tight bond between the phenolic surface and the top-coat enamel. Interchemical Corp. (D-526)

**NYLON COST CALCULATING.** Folder provides information to help calculate material cost of nylon part for comparison purposes. Costs are determined by part's volume in cubic inches. Typical example shows how proper part design yields savings. Nylon Molded Products Corp. (D-527)

**MIXING EQUIPMENT.** Bulletin illlustrates and describes mixers applicable to a wide range of floury, powdery, granular or free-flowing fibrous materials. Units specially constructed to handle volumes of from three and one half cubic feet up to 500 cubic feet. Young Machinery Co. (D-528)

**AUTOMATIC HYDRAULIC PRESSES.** Specifications sheet gives details on three new molding presses for handling thermosetting materials. Details given include platen area, stroke, closure speed, etc. Plastic Press Division, Baker Brothers, Inc. (D-529)

**TUNGSTEN FILAMENTS.** Booklet discusses the basic principles of using tungsten filaments for vacuum metalizing and outlines the advantages found in using multi-strand, rather than single filaments. Bergen Wire Rope Company. (D-530)

**PLASTICS FILM WINDER.** Bulletin on a constant tension winder designed to handle the lightest plastic film and other windable materials. Tool Engineering & Manufacturing Co. (D-531)

**GRANULATOR.** Details on machine for granulating all vinyl, polyethyylene and hot sprues. Machine is described as being applicable for cutting soft or hot plastics without fluffing and is quickly dismantled for cleaning. Injection Molders Supply Co. (D-532)

**EXTRUDERS.** Catalog covers a line of extruding equipment ranging from a one inch bench model up to an eight inch unit capable of handling as much as 800 pounds an hour. Sheeting dies and polystyrene sheeting haul-off units are discussed. Plastics Machinery Division, National Rubber Machinery Co. (D-533)

**INDUSTRIAL CHEMICALS.** Twenty-four page bulletin lists company's complete line of chemical products, many of which are used in the plastics industry as plasticizers, resins, resin-modifiers and extenders, or for polymerization. Hooker Electrochemical Co. (D-534)

**COLORANTS.** Data sheet lists 19 colors and furnishes price per hundred pound unit of paste or dry colors used in injection molding and extrusion or for polyester-fiber glass fabrication. Plastics Color Co. (D-535)

**PLASTICS AND THEIR COMPONENTS.** Brochure offers complete information on this company's line of molding compounds, industrial resins, surface coating resins, fabricating materials and adhesives, etc. Monsanto Chemical Co. (D-536)

**CUSTOM MOLDER.** Literature, including small sample kit, describes company's custom fabricating and sheet forming service using plastic sheets, rods, tubes and reinforced fiberglass stocks. Regal Plastic Company. (D-537)

**MOLDING EQUIPMENT.** Bulletin illustrates and gives specifications on ten different pieces of molding equipment, including horizontal hydraulic injection molding machines, vertical injection and compression molding machines, vertical hydraulic presses and transfer or plunger presses. Improved Machinery, Inc. (D-538)

**HOT STAMPING COLOR CHART.** Ten colors for hot die stamping on vinyl, polyethylene, acetate and other plastic surfaces are shown in a color chart produced by W. H. Coe Manufacturing Co., Inc. (D-539)

**POLYVINYL CHLORIDE RESIN.** Technical information on Diamond PVC-50, a polyvinyl chloride resin designed for general use. Specifications are given of the resin which is described as being particularly good for calendered film and sheet. Diamond Alkali Co. (D-540)

**HOT PRESS STAMPING MACHINE.** Fact sheet on small hand-operated stamping machine for gold or color roll leaf imprinting on small, odd-shaped plastic parts. Ackerman-Gould Co. (D-541)

**HYDRAULIC EQUIPMENT.** Eighteen-page catalog gives general information on this firm's line of hydraulic oil pumps, valves, controls and pressure-booster units. Racine Hydraulics & Machinery, Inc. (D-542)

**THERMOSETTING MOLDING COMPOUNDS.** Seventy-four page data book furnishes technical information concerning the physical, chemical and electrical properties of 30 "Fiberite" phenolic and melamine molding compounds. Discusses high density and conventionally made preforms and chart shows weight tolerances. The Fiberite Corp. (D-543)

**HYDRAULIC AND PNEUMATIC CONTROLS.** Catalog discusses manual valves, solenoid valves, solenoid pilot controlled valves, and pressure switches for use on presses and other equipment employing hydraulic or pneumatic power. Barksdale Valves. (D-544)

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## Cost Reduced

(*From pp.* 102-104)

section of the hopper. Removal of a thin film of flash from the four cored bolt openings and other final flashing are handled in another department after the part has been removed from the shrink fixture, designed to accommodate three parts at a time.

The molding of the two compressors in a two-cavity mold poses a somewhat different problem, because of the depth of the parts, the heavy wall section (1½ in.), and the fact that the knurled steel shafts are permanently molded into the parts as inserts. As shown in the photo on page 104, these parts are molded in a vertical position, requiring a fair amount of daylight opening since the shafts measure 9½ in. from end to end. In molding these parts, the shafts are placed upright in wells at the bottoms of the cavities and the preweighed molding material is packed around them. As the punch descends, the material is tightly compacted around the shafts by the 250-ton molding pressure. Due to the heavy wall section of the compressors, the molding cycle on these parts is approximately 9½ minutes. This set of dies is equipped with both top and bottom knockouts to insure proper ejection of the parts. No shrink fixtures are required.

### Deep Draft, Long Flow

The top section of the hopper involves no heavy sections but it has a deep draft and involves long flow of the molding material. It is produced in a single-cavity mold on a 150-ton compression press, using a molding cycle of about 5 minutes. Shrink fixtures are used to insure proper alignment of bearing slots.

In the Hollymatic plant, the only additional work done on the plastic parts is a milling operation on the top and bottom surfaces of the lower hopper section. This brings the part to the necessary dimensional tolerances and makes certain of a smooth, accurate fit with the upper hopper section and the bed of the machine.

The stainless steel hopper feed tray which is to be replaced later with a molded plastic part involves an expensive forming operation, as well as a welding operation during which the square collar which fits down over the top of the hopper is joined to the tray. With this construction, it is difficult to eliminate overlapping metal surfaces which tend to retain small amounts of ground meat and make thorough cleaning more difficult. The one-piece reinforced plastic feed tray, to be molded of the same type of material used for the other parts, will eliminate this problem and will also reduce production costs, Hollymatic representatives point out. It will be made with tapering radial ribs which will make the entire assembly more rigid, eliminating "rocking" when meat is loaded into the top of the unit.

CREDITS: Parts for Hollymatic patty molding machine are molded by Imperial Molded Products Corp., Chicago, Ill., using Thermaflow molding compound produced by Thermaflow Chemical Corp., Tunkhannock, Pa. Polyester resin in the compound is Atlac, from Atlas Powder Co.; fibrous glass reinforcement is from Owens-Corning Fiberglas Corp.

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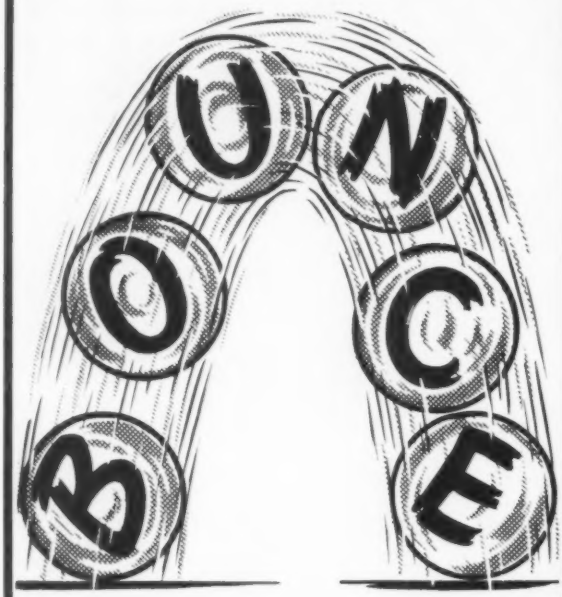


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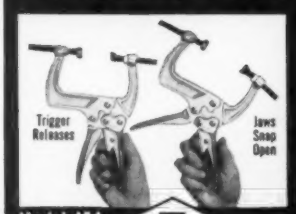


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## Molded Cases

(*From pp.* 112-113)

bility, light weight, and attractiveness as the medical kit.

Compact design is also an outstanding feature. By including a platform tray insert in the design of the case, Henry L. Hanson Co., Worcester, Mass., manufacturers of the precision tools, were able to package in a single unit the same number of taps and dies that previously required the use of two separate wooden boxes. And because of the light weight of the material, the molded polyethylene case completely filled with taps and dies still weighs less than one of the wooden boxes weighed when empty. Contoured cavities to accommodate each of the tools in the set are molded into both the bottom of the case and the platform tray.

The one-piece construction of the case, with its integral self-hinge, besides effecting economies in production — the polyethylene case costs less than the wooden one — helped eliminate a basic disadvantage of the wooden boxes. Since the cover of the wooden box was heavier than the base, a severe strain was imposed on the metal hinge, often causing it to fail after several months of use. The resilient polyethylene self-hinge, in contrast, proved tough enough to withstand all the abuse given to a tap and die set during the normal course of shop work. A snap fastener holds the front of the case together.

Because the case can be molded in different colors and can be readily hot-stamped with any trademark needed, the company has found that it is especially adaptable to the marketing of private brands of tools. An attractive grain pattern is molded into the exterior of the case.

As demonstrated in the tap and die case, polyethylene is ideal for packaging any type of tool whose fine cutting edge must be preserved. The soft, cushioning effect of the polyethylene coupled with the fact that pieces can be easily molded with contoured cavities assures protection for the cutting edges that few other materials could afford.

CREDITS: Welch Allyn, Inc. medical kit is molded by Auburn Button Works, Inc., Auburn, N. Y.; Henry L. Hanson Co. tap and die case is molded by Prophy-lac-tic Brush Co., Florence, Mass.


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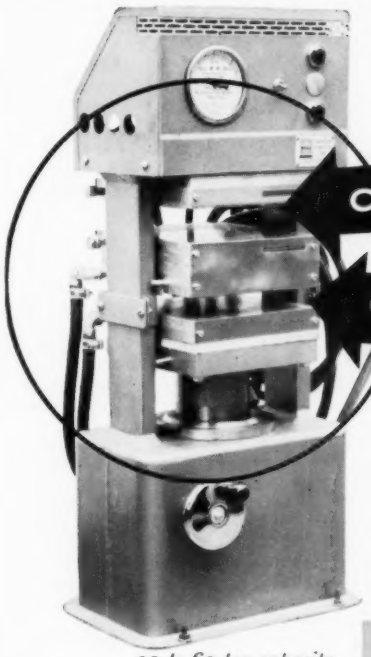

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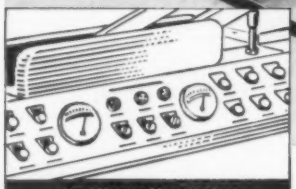

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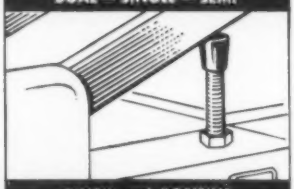

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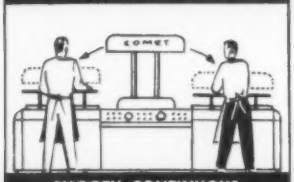


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## Runnerless Injection

(*From pp.* 119-126)

conception of hot-runner molding. A small square runner bar is fastened to the stationary half of the mold. An air gap is provided on both halves of the mold to prevent excessive heat transfer. Nozzle plates are installed in the hot-runner bar with $\frac{3}{16}$ in. square nozzles coming into direct contact with the cavity plates. The cavity blocks themselves are water cooled. The runner bar is heated with cartridge heaters and temperature control is maintained. The bars and blocks of steel that form the ends of the molded parts are located on the movable side of the mold.

When the mold opens, the bars actually lock the parts into the movable half of the mold and shear the gates. As the platen completes its travel, these bars engage the knockout rods and are moved forward, removing the pieces from the cavity. An air blast frees the molded parts and permits them to fall free. A mold of this construction was actually built but its operation was only fair, due to the fact that the runner bar was too small. From the experiments that have been run, however, it is evident that, with good mold engineering, this type of mold construction can be entirely satisfactory.

### Runnerless Production of Phonograph Records

In studying the injection molding of phonograph records, it has been found that it is generally considered necessary to heat mold platens to a temperature of approximately 150 to 160° F. This temperature is very near the softening point of styrene record compound and, accordingly, cycle time is rather long and the records must be cooled externally from the mold.

Normally, a nozzle is used with a hole the size of the center hole in the record, or approximately 0.286 inch. The injection is made from this large diameter nozzle opening through a passage of this diameter into the record cavity. After the passage and cavity have been filled with plastic and pressure has been held for a sufficient length of time to set the record, a punch is actuated from the movable platen side of the mold to pierce a hole of spindle size

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(0.286 in.) through the record. This punch not only pierces the hole but continues in its movement until the entire slug is moved back into the injection nozzle. This material must then be re-heated so that it can be used in the next cycle. It is the writer's belief that it is a physical impossibility to heat this slug in the approximately 30 sec. available in the molding cycle. So, under the circumstances, the slug must be re-heated by the passage of hot plastic from the material cylinder on its way to produce the next record. This, it appears, is the reason why it is necessary to maintain a very high mold temperature in the successful molding of records.

### Direct Runnerless Injection

The following is a description of a direct runnerless injection method to achieve the same result more efficiently. Figure 11, p. 126, shows two cross-sections of a hypothetical phonograph record mold. Cross-section 1 shows a 7-in. diameter record completed in the mold, with a standard spindle hole. The point of discussion is the nozzle construction. Here the nozzle is actually used as a core and forms the hole in the record. Plastic is sent through the core, or nozzle, through a group of very tiny holes to form the record. The machine or mold is so arranged that, as the clamp opens, the entire mold moves away from the nozzle, stripping the record from the nozzle. After the mold has moved approximately ⅜ in., it then opens, the record is held in the movable half of the mold, and is ultimately ejected.

Cross-section 2, Fig. 11, shows a slightly different nozzle construction for 7-in. 45-r.p.m. records with a center hole approximately 1½ in. in diameter. For this mold, a two-piece nozzle has been constructed as illustrated. An opening 0.010 in. wide is provided completely around the 1½ in. diameter nozzle. Plastic is forced through this slight opening, filling the cavity, and, as described above, the mold is opened, the rear platen moves to strip the mold from the nozzle, the rear platen continues to travel to the knockout rod, and the record is ejected.

Records have been successfully molded by this method, in molds having temperatures as low as 90 to 130° F. and on cycles as rapid as 12 seconds. Records made with this method are ready to label as they leave the mold. No secondary cooling is necessary. Records molded with the method first described must be held between cool platens or cooled after they leave the mold cavity.

### Consideration Needed

After all this discussion of runnerless injection molding, hot nozzles, and molding problems that have been solved, it must be repeated that no attempt has been made to present exact details of mold design. The main purpose has been to show how, through research and development, the experiments described have been successfully proved on automatic injection molding machines.

By applying the fundamental engineering approaches outlined, injection molders can operate on a more profitable basis if they will give careful consideration to those factors by which both sprues and runners can be eliminated from the final cost analysis.—End


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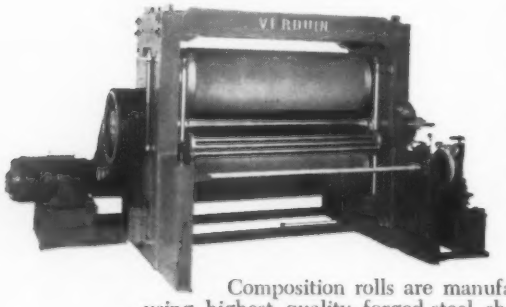


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## Heating Cylinder

(*From pp.* 127-136)

sure drop through the molten polymer or fluid zone

$$\Delta P_T = \Delta P_G + \Delta P_F \quad \text{Eq. 18}$$

or

$$P_m - P_b = \gamma P_m + \Delta P_F \quad \text{Eq. 19}$$

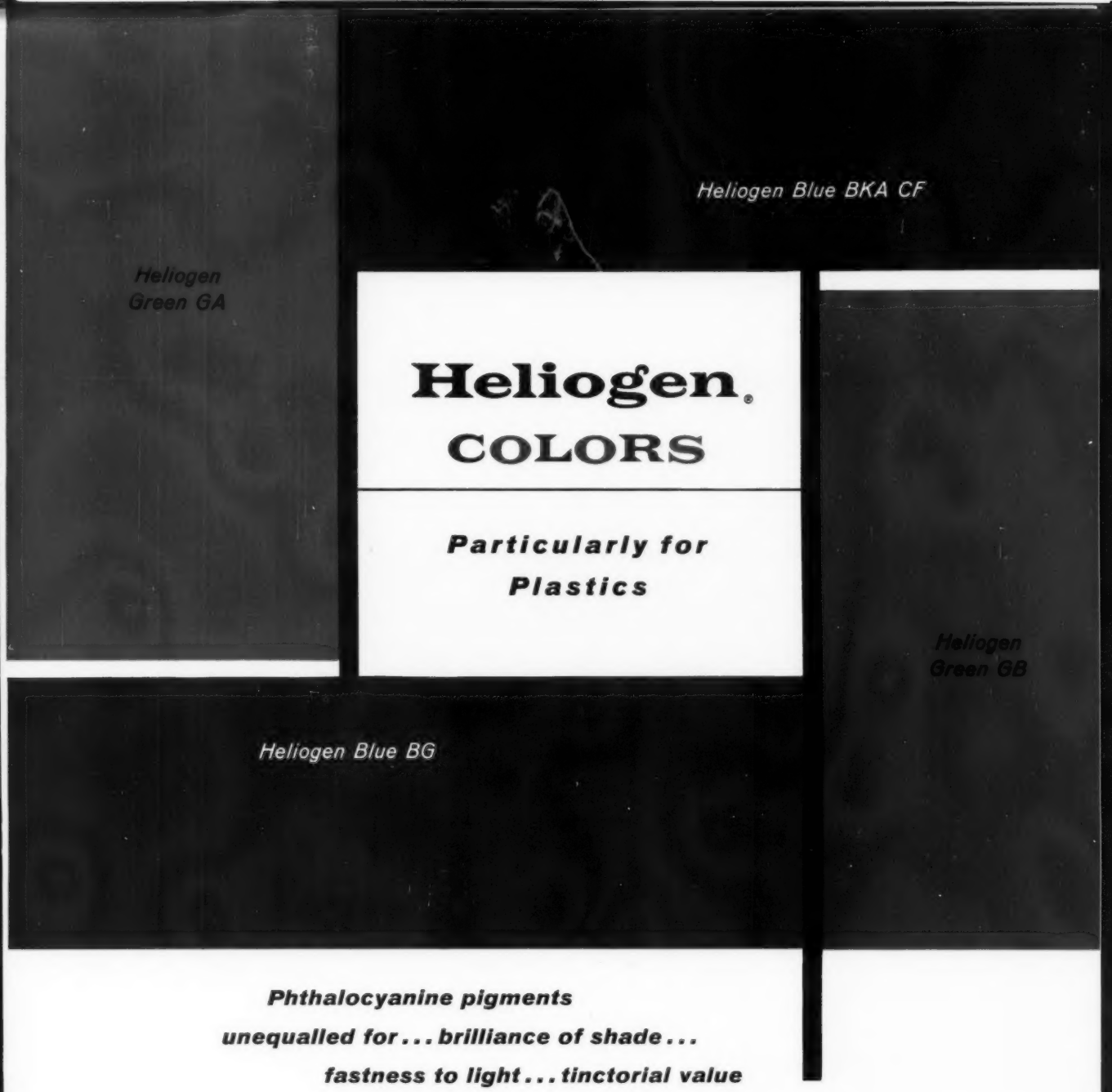
where $P_b$ is the back pressure exerted on the heating cylinder by the resistance to flow in the mold passages, and $\Delta P_F$ is the pressure loss in the fluid zone.

When the total pressure drop is plotted as a function of the ram pressure, the result should be a straight line with a slope of $\gamma$ and an intercept on the ordinate equal to the fluid pressure loss, agreeing with experimental result (Fig. 10, p. 135). Values of $\gamma$ and $\Delta P_F$ can be easily calculated from these data. By multiplying $\gamma$ by the desired ram pressure, the pressure drop through the granules and through the molten polymer are known and the total pressure drop in the cylinder will simply be the sum of these.

When the total pressure drop is plotted as a function of the ram pressure, from eq. 19, the result is a straight line with the slope $\gamma$ proportional to the frictional resistance and the $y$ intercept proportional to the viscous resistance. Because the flow conditions existing in the heating chamber differ widely from those in a viscometer, this development has not been carried further. This interpretation, only a first approximation, is at present sufficient to explain the data.

The properties of the polymer will have a large effect upon the pressure losses through the heating cylinder. In the frictional zone, such variables as the amount of external lubricant and granule size and shape will affect the pressure losses, while in the viscous or molten zone the viscosity and shear dependence of the material will affect the pressure losses.

The question of how much external lubricant to put on the granules will probably be one of long standing. A very small amount will affect the compaction of the granules; a little more will help the flow. To evaluate the effect of lubricant on the pressure losses through the heating cylinder, several packs of one given lot of poly-

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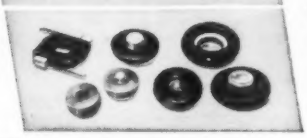

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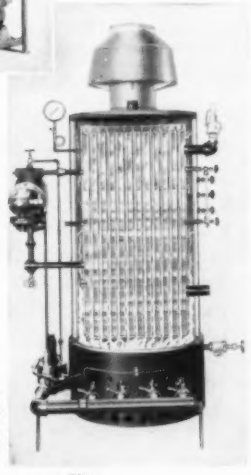

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200 p.p.m. lubricant— 7,800 p.s.i.

The frictional component of the pressure loss drops rapidly until a lubricant concentration reaches 200 parts per million. Beyond this there is not much change.

The size of the shot or length of the granular plug will also affect the slope of the pressure drop curve as shown in Fig. 12 (4). As the shot size increases, the slope also increases up to a critical granule length. Beyond this, enough molten polymer has formed next to the wall so that it acts as a fluid lubricant. This would indicate that the frictional pressure loss will also depend somewhat on the melting temperature of the polymer and the sooner it becomes fluid the shorter will be the length of the granular plug. This also indicates that the frictional pressure drop, which is as much as 80% of the total pressure loss in the heating cylinder, is concentrated in a very short space directly in front of the plunger.

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## Laminate Durability

(*From pp.* 139-154)

in. thick and to maintain high perpendicular dielectric strength in operation. Table IV, p. 154, shows that the dielectric strength of phenolic resin A-1 used in laminate No. 16 deteriorated badly after seven days at 200° C. This was in contrast to a relatively low weight loss shown in Table II (laminate No. 16) and good cold flexural retention shown in Table III.

Extreme degradation of the dielectric strength of phenolic resin A-2 (Table IV) occurred even at 125° C. This is in contrast to its good behavior in the weight loss (laminate No. 17, Table II) and flexural strength tests. It was assumed that this loss of dielectric strength was caused by crazing of the resin.

A number of other phenolics were tested, especially some which were known to soften upon heating. Resins C-3 and C-5 show excellent retention of dielectric strength up to 225° C. From the known nature of these resins, it is unlikely that they could ever be considered heat resistant for mechanical use. It becomes quite clear that "heat resistance" must be defined in terms of the property desired, that "heat resistance" for one application may represent a total lack of it in another. Resin D-1 (an epoxy) is of special interest since it apparently withstood 250° C. for seven days without loss in dielectric strength. This would correlate well with the behavior of laminate No. 8, which showed an epoxy resin (not the same one) to soften greatly upon heating. Ability to soften is likely to be associated with craze resistance. This same conclusion is suggested in resin E-1. This resin ultimately decomposed, but until this point was reached, no loss in dielectric strength occurred. It is also known that silicone resins that exhibit good dielectric strength after heat-aging also show very low hot flexural strength.

### Conclusions

Heat resistance must be defined in terms of the specific property under consideration. The properties listed in Table V, below, are of interest in evaluating certain characteristics of resins: The property, when plotted in three dimensions against time and temperature, gives rapid appraisal of the nature of the resin under consideration. Recently developed phenolic resins show promising heat resistance for mechanical applications. Some standard types may be more craze resistant. Diallyl phthalate, and especially epoxy resins, exhibit remarkable resistance to crazing, although they soften upon heating. Probably these two phenomena are closely related.

**Table V—Properties for Evaluation of Resins**

| *Property* | *To evaluate* |
|---|---|
| Weight loss | Ultimate decomposition |
| Cold flexural strength | Ultimate decomposition |
| Hot flexural strength | Degree of cure, degree of softening |
| Cold perpendicular dielectric strength | Crazing |

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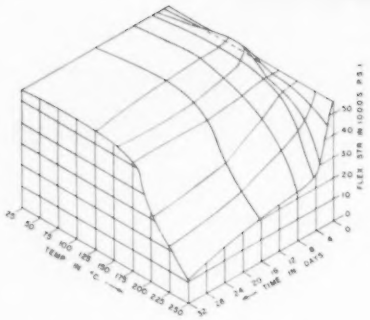

Fig. 10—Room temperature flexural strength-time-temperature diagram for phenolic-glass laminate No. 16

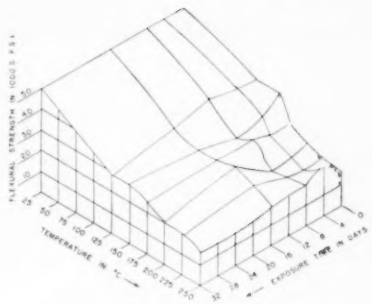

Fig. 11—Hot flexural strength-time-temperature diagram for silicone-glass laminate No. 14


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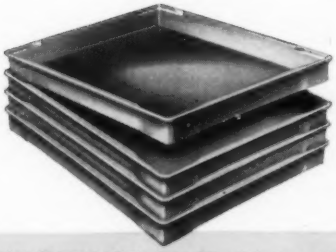

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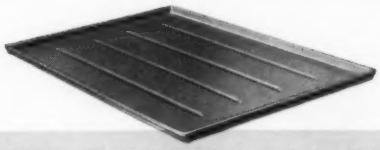

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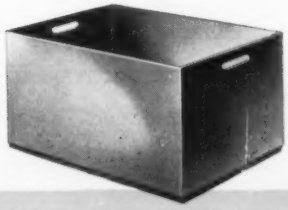

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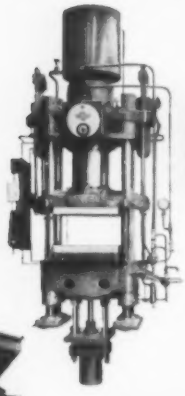

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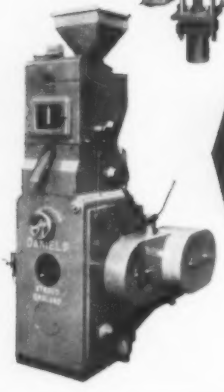

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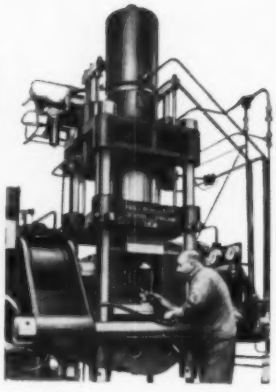

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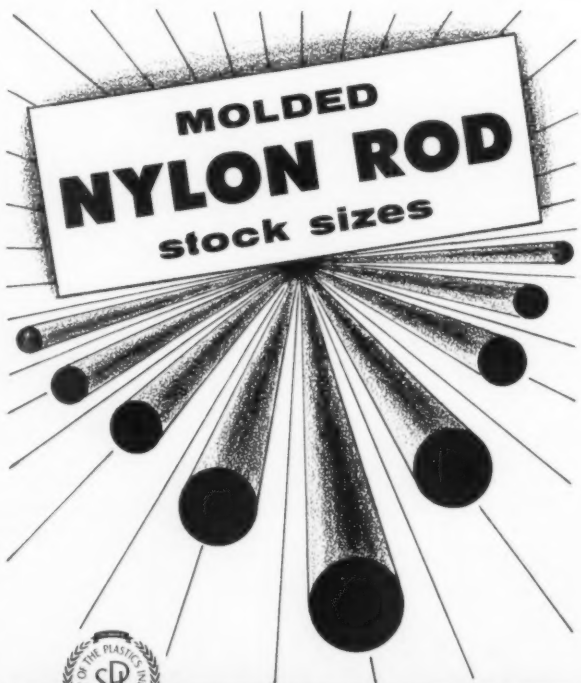

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# Epoxy Resins

(*From pp.* 164-166)

curve, it is noted that at 200 min. the resin mixture has reached gelation. Thus, this rate is too small to extend the pot life indefinitely.

With the cessation of replenishment, the viscosity increase is similar to the pot life curve.

### Triggering the Reaction

The speed of the reaction increases with increasing temperature. Figure 4, p. 166, shows a series of pot life curves at different temperatures.

Many applications may best be handled by triggering the reaction. In a continuous system, the resin may be heated in the outlet at the point of application. The result is a lower initial viscosity and faster curing.

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*Reactive diluents*—A class of materials such as styrene oxide, epichlorohydrin, and acetonitrile reduce viscosity and copolymerize with the resin.

*Fillers and reinforcements*—To increase impact resistance, reduce the danger of cracks or crazing, increase viscosity, and lower the cost, asbestos, mica, silica, aluminum powder, and glass fiber may be mixed with the resin.

*Pigments*—To impart color and opacity, pigments may be dispersed as solids or pastes. The pigments should be able to withstand the high exothermic temperatures.—END

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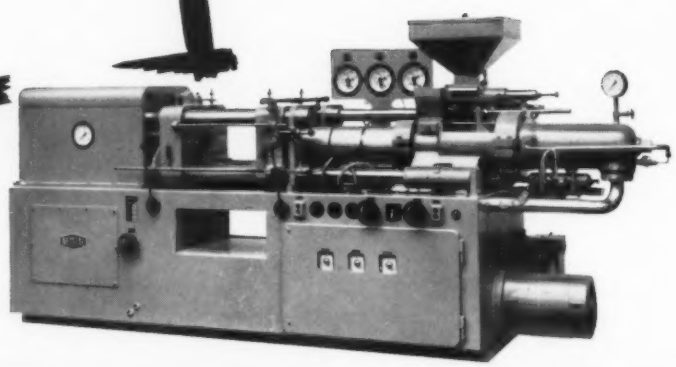

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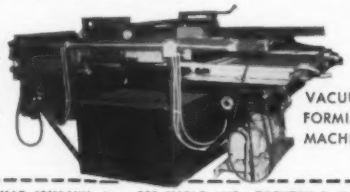

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# THE PLASTISCOPE*

NEWS AND INTERPRETATIONS OF THE NEWS

By R. L. Van Boskirk

## Polyethylene on the March

ACCORDING to recent activities in the plastics industry, a slight upward revision of nearly all 1954 sales estimates for plastics materials made in the January 1955 issue of MODERN PLASTICS seems to be in order. The reason for the revision is the unusually good sales period which the industry experienced in November and December of 1954. The MODERN PLASTICS sales estimate was made in late September and early October of that year, at a time when almost no one could foresee that November sales would go above October—a most unusual performance for the plastics industry. Another factor was that October sales barely topped September, whereas October is generally much higher. Such a performance made forecasters chary of predicting good months in November and December.

As a result, on the basis of the new figures, it seems likely that 1954 sales were probably slightly more than 1953, instead of slightly less.

The greatest factor behind the increased sales figure for 1954 was the growth in sales of polyethylene. A gain of around 55 or 60 million lb. in sales of this material more than offset the drop of some 30 million lb. in phenolic molding powder and various small declines in sales of some of the other materials.

There have been numerous estimates on polyethylene sales for 1954, some of them going as high as 220 million pounds. A recent check by this magazine, however, indicates that a 200 million lb. sales estimate is a good, strong figure and may even be a little high. This figure includes exports for the year 1954 which were estimated at substantially over 10 million pounds.

Production capacity for polyethylene at the end of 1954 was estimated at around 26 million lb. a month or 300 million lb. a year, which, incidentally, is the figure most commonly used in estimating possible sales totals for 1955. The above 300 million-lb. capacity figure includes the Bakelite Seadrift plant which began operations in late 1954 but didn't reach full capacity potential until early 1955.

Capacity to be brought in by new companies in 1955 is rated at 180 million lb., but only two or three of these companies are expected to be producing commercial quantities by mid-year. There is some doubt that the others will be ready to operate at maximum capacity before late 1955.

The new 60 million lb. Bakelite plant in California, originally scheduled to start production in late 1955, will not be completed until early 1956.

Eastman Chemical came in late in 1954. Spencer Chemical started deliveries in early March. Monsanto, too, is now in operation. Dow has announced that molders are being supplied with their polyethylene for evaluation purposes, but the main plant at Freeport, Texas, is not yet quite ready. National Petrochemical is due to begin operations in mid-year or sooner and Koppers is scheduled for fall production. But everyone knows that a protracted period of time is almost always necessary to get the "bugs" out of a polyethylene production line before maximum production is possible.

It is even possible that if a national emergency should arise in 1955 polyethylene would go on allocation—unless all the new plants have surprisingly good luck with their production operations.

In the meantime, sales are booming along at a very good rate with film and molded items leading the procession. Film sales may go from 70 million lb. in 1954 to 115 in 1955. Molders are finding new market outlets for polytheylene so rapidly that they may consume as much as 40 to 50 million lb. in 1955 compared to between 30 and 35 in 1954.

New and startling uses for the material continue to sprout up. An aerosol container, for example, is under experimentation. Another unusual job is a food container vacuum formed from a sheet of polyethylene, 20 mil thick. A cylindrical bottle used as a powder container looks as though it may sweep the market. The nursery bottles brought out in 1954, are still growing sensationally. The idea that polyethylene film can be coated with other materials to improve its properties is beginning to take form . . . and many, many more unusual items are in the works.

Of course there will be halts and road blocks along the way when polyethylene is oversold to do jobs it was never intended for. Nor are mechanical problems in handling the material by any means completely eliminated.

In addition, not all the promising applications for polyethylene are working out as expected. Pinch bottles, for example, have grown more slowly than had been anticipated, because the material is not suitable as a container for some drugs, pharmaceuticals, and cosmetics. Nor has polyethylene-coated cellophane made the progress expected. Polyethylene-coated wire for civilian use takes time for testing but is expected to become a sure-shot, big volume use within three or four years.

But by and large this looks like a good year for polyethylene. Salesmen will have to dig for orders, 'tis true, but at this point it doesn't look as if there will be any huge supplies of polyethylene just waiting around for some one to claim them.

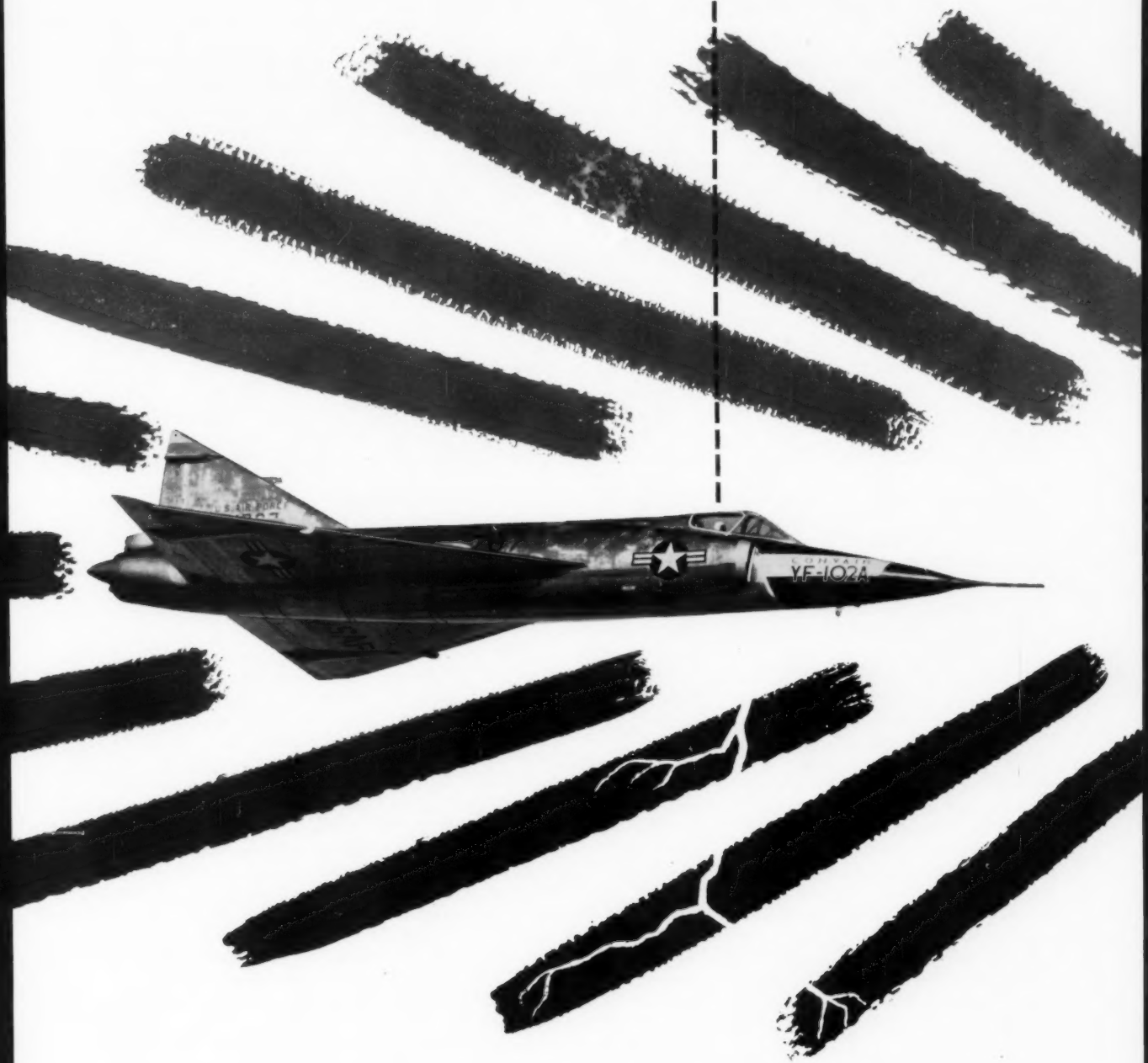
Perhaps the most startling of all recent news about polyethylene is the Bakelite announcement that the company will soon offer experimental quantities of a new type polyethlyene with greater rigidity and higher temperature resistance, produced under conditions that approximate atmospheric pressure and temperature. Softening points up to about 240° F., which is at least 20 to 30° higher than conventional polyethylene, are promised.

It is expected that the new material will broaden the base for polyethylene products rather than

* Reg. U. S. Pat. Off.

# VISIBILITY by Swedlow

## IN THE CONVAIR YF-102A




**The new** supersonic F-102 all-weather Air Force interceptor, a product of General Dynamics Corporation, is now in production by their Convair Division in San Diego, California.

This recent addition to our defense team has a specially designed canopy to give greater visibility for the pilot.

Because of its critical optical requirements, the production of the canopy was logically entrusted to Swedlow's specialized skill and experience in plastic enclosures.

For information regarding transparent plastic glazing applications, contact the Swedlow plant nearest you.

**Swedlow PLASTICS CO.**

LOS ANGELES, CALIFORNIA • YOUNGSTOWN, OHIO

# THE PLASTISCOPE

cut deeply into present uses for conventional polyethylene.

A note from our informant on what's going on in Germany is pertinent at this time. He states that one plant there is now operating at a 1,000,000-lb. annual rate and that Rheinische Olefinwerke at Wesseling-Rhein, a mutual company of Shell and Badische Anilin is constructing a high-pressure polyethylene plant with a 14 million-lb. annual capacity. Furthermore, Farbwerke Hoechst A.G. will soon have a small low-pressure polyethylene plant in production and a bigger one at the end of the year. More development work is necessary, however, before the company will be satisfied with its product. Other licensees of the Ziegler process like Ruhrchemie and Hibernia are expected to follow later. Several American companies have also obtained licenses to operate under the Zeigler process but have made no public acknowledgment of their acquisition.

### Hatco Plasticizers and Polyesters

SEVERAL new plasticizers have been added to the line of Hatco Chemical Co., Fords, N. J. Octyl decyl phthalate, a plasticizer that has been making rapid progress in the industry over the past year because of its permanence and improved low-temperature characteristics, is one of the new plasticizers to be added. Didecyl adipate is another. This is a specialty material costing 43½¢ a lb., but is necessary to prevent viscosity build-up of plastisols and for use when extra good low-volatility and low-temperature flexibility in vinyls is desired.

Butyl decyl phthalate, a plasticizer lower in cost than D.O.P. and which can often be used as a replacement or additive to D.O.P. (even though it has somewhat higher volatility), and dibutoxyethyl adipate for vinyl butyral sheeting have also been added to the Hatco line.

Significant of its faith in the future of polyurethane foam is the fact that the company is now producing polyester resins for use with isocyanate to produce polyurethane on a semi-commercial basis. This type of polyester is primarily a formulation of glycols and adipic acid, while the polyester used with fibrous glass is usualy styrene, glycol, and maleic. Polyesters are said to be the key to polyurethane development. The isocyanate cannot be changed, but it can be reacted with a polyester which can in turn be varied to meet the need for which each particular polyurethane is designed, whether it be for flexible foam, rigid foam, coating material, or any of the other uses for which polyurethanes are being suggested.

Hatco moved to its new 65-acre plant in Fords a little over a year ago from Kearny, N. J., where the company was set up in 1950 for the manufacture of glycerine, fatty acids, and various other derivatives. Fords is between the New Jersey Turnpike and Garden State Parkway, near Perth Amboy on the King George Post Road. William Hackman is president of the company and John (Spike) Conway, formerly assistant sales manager of Carbide and Carbon Chemicals, Div. of Union Carbide and Carbon Corp., is sales manager. Both men were plasticizer specialists with WPB in Washington during World War II.

### New Type Silicone Rubber

PRODUCTION quantities of a new type silicone rubber, called W-96 Silicone Gum, are now available from the Silicones Dept. of Linde Air Products Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y. The company claims that this material offers important features never before available in silicone rubber.

Secret of the unique properties of W-96, according to Linde, is that a controlled number of reactive groups have been built into each silicone molecule. These reactive groups determine the final structure of the cured rubber. It is this "controlled reactivity" that gives advantages in curing the rubber, as well as special properties in the cured product. As far as can be determined, this new gum will do all that previously known methyl silicone gums and their compounds can do, but at the same time possesses many striking advantages, with possibly more to be discovered.

Unusually low compression set is one of the properties that Linde sees as being of particular importance, especially since these low values are present over a wide range of hardnesses, using conventional fillers. Negligible sacrifice of tensile and elongation increases the significance of these values. To product designers this means a major improvement over other silicone rubbers for gaskets, O-rings, and a variety of other molded parts.

Good resistance to high-pressure steam is another new property that Linde believes will be of interest to designers, although thick section cures, without the need for programmed postcures may be of even more widespread interest.

Another feature of W-96 is that this material can be filled with a variety of carbon blacks. Even semiconductive silicone rubber is now possible.

### Calendered Rigid Vinyl

CALENDERED rigid vinyl sheet with an improved surface finish and in much greater thicknesses than were formerly available has been announced by Bakelite Co., Div. of Union Carbide and Carbon Corp. The calendered material is now obtainable in thicknesses from 0.005 to 0.040 inch. Continuous sheeting up to 51½ in. wide or single sheets up to 51½ by 72 in. are available. A surface finish comparable to that of the more costly press-matted product can be produced by the new Bakelite technique.

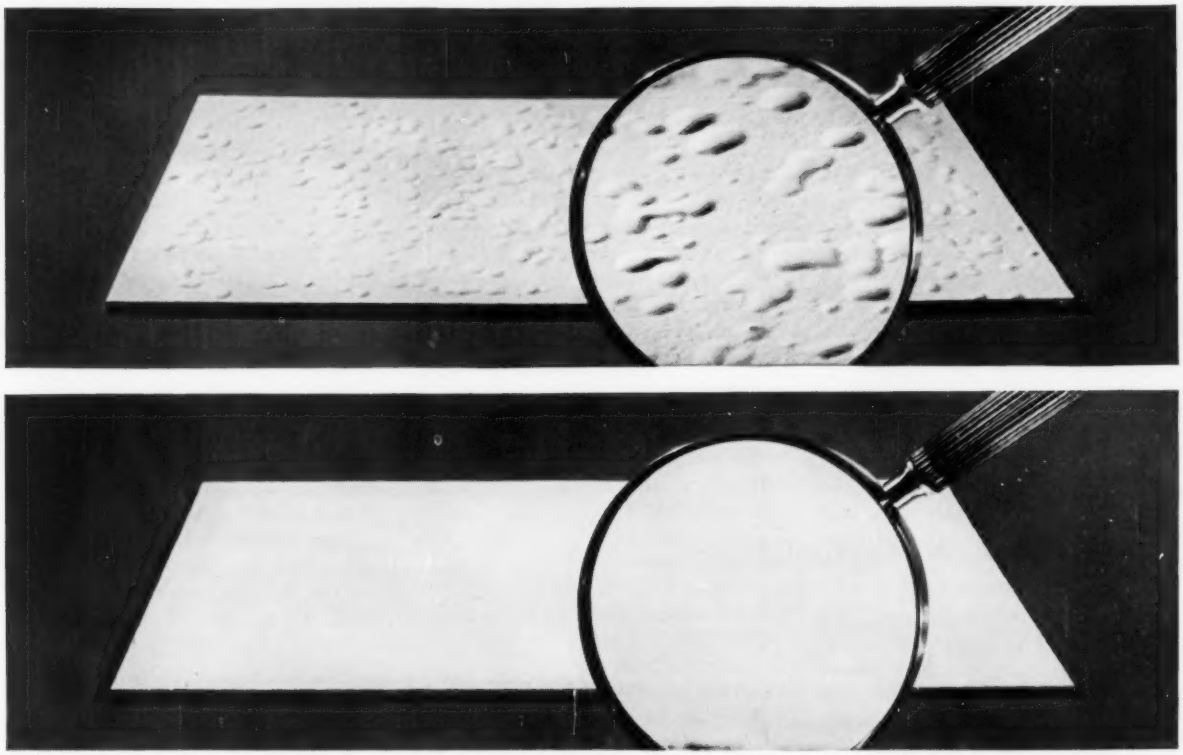
According to J. B. Knowles, manager of the Film and Sheeting Div., this development makes the new Bakelite rigid vinyl sheet competitive with other plastics materials and with metal for many applications. He states that its greatly improved light stability makes the new rigid sheet especially preferable for lighting fixture applications. Tests show no change in light transmission values, color, or other significant properties of the new rigid sheet after 15,000 hr. of continuous exposure to fluorescent light. It does not support combustion.

The characteristics of the sheet also make it an ideal material for products such as deep-drawn can

DOW

# DOW VINYLTOLUENE

## IN POLYESTER RESINS HELPS FABRICATORS ELIMINATE BUBBLING IN THE MOLD



*The top panel above shows "bubbling" resulting from monomer vaporization at the curing temperature. Under the same curing conditions vinyltoluene diluted resin resulted in smooth, bubble-free molding.*

**Polyester resins modified with this Dow monomer can be fabricated at higher temperatures for less bubbling and shrinkage, more faithful mold reproduction!**

Dow vinyltoluene offers you many advantages over styrene for modifying polyester resins. Its higher boiling point means fabricators can operate at higher temperatures, eliminate bubbling and shrinkage in the mold. The reduced vaporization reduces fire and nuisance hazard. Vinyltoluenated resins also gel and cure faster than styrenated resins.

Dow vinyltoluene saves money, too, because it allows a higher percentage of monomer in the resin. If you're making polyester resins, it will pay you to investigate the price and properties of Dow vinyltoluene.

Write to
Dow Plastics Sales Dept. PL 535E
THE DOW CHEMICAL COMPANY
Midland, Michigan

**GREATER DILUTION...LESS LOSS IN VISCOSITY!** *The diluted polyester resin, right, contains 25% vinyltoluene as the solvent, while the resin on the left contains 21% styrene as the solvent. Yet their viscosities are the same!*

*you can depend on DOW PLASTICS*

DOW

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liners, as well as for vacuum forming three-dimensional advertising displays. It is now possible to silk screen, print, or otherwise predecorate the flat sheet so as to achieve excellent undistorted register when the piece is vacuum formed. According to Mr. Knowles, complex shapes have been formed with as little as eight seconds preheat time, using relatively inexpensive equipment.

Company officials have not stated whether the improved sheet is produced from Bakelite's new rigid P.V.C. resin or from the older and more familiar vinyl chloride-acetate copolymer resins.

### Sales Service Laboratory

LABORATORIES have become just about as essential to the plastics enterprise as the capital with which to operate, but a super-super structure like the new Du Pont $3 million sales service laboratory is an eye opener. Here under one roof and under actual operating conditions can be seen practically any type of equipment a thermoplastic molder or extruder is ever likely to use, and every piece of it almost constantly in use to help improve some phase of the industry, including that most important one of finding more and better ways to use thermoplastics.

More than half of this laboratory's activities are devoted to assisting its customers to solve their problems, according to Elmer F. Schumacher. Most of the other activities are concerned with development work on new materials and processes, or evaluation of new materials. Behind these operations is a deeply embedded philosophy that the laboratory shall be used to educate users of plastics materials and develop comparable knowledge.

**Extrusion of Teflon**—Among the highlights shown to visitors on opening day were equipment and techniques for processing Teflon. There was a ram extruder for rod and pipe, a ram-type wire coating extruder, an extruder for compounded Teflon, a wire-calendering machine, a sintering oven, and hydraulic presses. Teflon processing is considerably different from other operations in plastics—it is almost unbelievable to see how techniques have been developed to overcome the problems encountered in handling this almost indestructible material—but now that the techniques have been mastered, standard patterns of procedure can be expertly planned.

Zytel nylon also made a good showing. In addition to conventional molding and extrusion operations, including extrusion of rigid shapes, Du Pont exhibited various machining operations on Zytel block and rod where patterns of prospective new products were being cut out.

The Alathon polyethylene exhibit featured a polyethylene paper coating operation with the extruder located on a base that can be raised or lowered according to the need and with the roller coating machine carrying the paper placed at a right angle to the extruder.

Faith in the future of extruded methacrylate sheeting was amply demonstrated here by Du Pont, apparently devoting unusual effort to perfecting this lower cost method for producing acrylic sheet—a method which Du Pont has consistently advocated as the pathway that will lead to far greater sales of sheeting.

**Plastics in Use**—A noteworthy feature of this laboratory is the use that has been made of plastics for functional purposes. Most sensational of all was the floor tile made from Hypalon, a rubber derived from chlorosulfonated polyethylene, that can be vulcanized. Today it costs even more than Neoprene rubber, but some Du Pont officials seem to think that Hypalon will eventually be practical for flooring.

Alathon has been used in the laboratory on high-voltage (12,000 v.) primary feeder cable where it serves as both insulation and jacket —the latter permits cable to be buried without use of a conduit; as insulation for 440-v. feeder cables; for exhaust ducts and vent pipes; for ventilating air filters; and for lubricating oil cans.

Zytel nylon was pointed out in such uses as bushings in door hinges; gears in venetian blinds; bearing pads on desk drawers, door lock rollers, and innumerable gears, bushings, bobbins, and levers in business machines and movie projectors.

Lucite methacrylate sheeting was profusely used in the laboratory building for such things as 4- by 4-ft. translucent ceiling fixtures, prismatic light diffusers, and reinforced monomer-polymer laminated wall panels.

### Vinyl Chloride Lining

DEVELOPMENT of a material which makes possible the lining of large tanks, vessels, and other equipment with unplasticized polyvinyl chloride has been announced by Kaykor Industries, Inc., Yardville, N. J.

Designated as Vyflex FL-85, the new lining is a special continuous laminate of unplasticized polyvinyl chloride on one face and plasticized polyvinyl chloride on the other. Therefore, the desirable strength and corrosion resistance of the unplasticized material is combined with the flexibility and ability of plasticized P.V.C. to be bonded to steel, concrete, or wood. The laminate, which does not require curing, can be installed quickly in large or small equipment by qualified applicators located throughout the United States and Canada.

Among the other advantages of Vyflex FL-85 over conventional linings, are maximum operating temperature of 200° F. and increased hardness and abrasion resistance. The wear properties of FL-85 are such that masonry sheathing, when used purely for mechanical protection, can often be eliminated.

### Progress in Kel-F

GROWTH of uses for Kel-F that go far beyond its original adoption for molding and extrusion were outlined recently by Walter J. Merck, sales manager of The M. W. Kellogg Co.'s Chemical Manufacturing Div., Jersey City 3, N. J.

"Molding and extrusion uses have, of course, grown steadily over the past 10 years," said Mr. Merck, "but the field for Kel-F is broadening into such things as dispersion coatings, film, and elastomeric materials.

"Dispersion coatings, which may be applied by spraying, dipping, or spreading and which retain all the important properties of molded or extruded Kel-F, can be applied to

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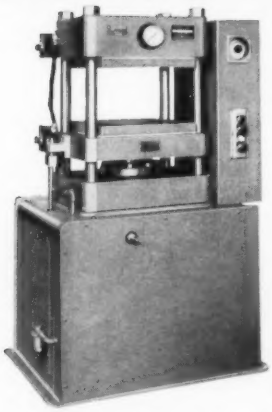

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many metallic and non-metallic surfaces. A few applications are plating coils, expansion joints, valves, shipping containers, pipe lines, and many similar uses."

Kel-F elastomers will be useful in fields requiring extreme resistance to oxidants such as fuming nitric acids, oleum, 90% hydrogen peroxide, ozone, oxygen, as well as to weather. The elastomer has thermal stability up to 400° F.; exceptional chemical resistance to most oils at high temperatures; and extremely low moisture absorption.

Kel-F film has become increasingly important since means have been found for sealing it. The problem was difficult originally because there are no known solvents, but it has been found that the film can be efficiently sealed by thermal impulse and hot jaw sealing. The film possesses extremely high strength and resistance to chemicals. Silk screen and rotogravure printing techniques can be applied, but because of antisticking qualities, specially developed polymer inks must be used. Films formed by extrusion are available in thicknesses from 2 to 10 mil.

In addition to glass cloth laminated with Kel-F plastic, oils, waxes, and greases made from Kel-F polymer are gaining more attention as the materials become better known.

### Benzoate Plasticizers

CURRENT prices of two plasticizers have been announced by Tennessee Products & Chemical Corp., 350 Fifth Ave., New York 1, N. Y., as follows:

Tank-car or tank-truck quantities of Benzoflex 9-88 (dibenzoate ester of dipropylene glycol) now sells for 27¢ a lb. and Benzoflex 2-45 (diethylene glycol dibenzoate) sells for 26¢ a pound.

### Service for Mold Builders

BUILDERS of large molds can now avail themselves of a service being offered by Custom Engineering Co., 2414 McKinley Ave., Erie, Pa., for roughing of big die blocks.

The company states that its service effects a minimum saving of 25% through a combination of special machinery and low operating costs. The service includes squaring, facing, rough or finish boring of holes for leader pin and bushings, deep drilling for water or steam circulation lines, and other mechanical operations.

Custom Engineering also manufactures and supplies standard and special steam or electric platens for the plastics and rubber industries. The platens are guaranteed and tested for 700 p.s.i. Special platens up to 10 ft. wide by 40 ft. long and in thicknesses up to 5 in. can be made to specifications.

### Du Pont's Breathable Vinyl

GRADUALLY the vinyl film, sheeting, and coated fabric industry is getting away from its initial habit of copying leather and fabric patterns. Many merchants have pleaded with the industry to stop copying and make a start toward developing vinyl as an interesting new material that has numerous possibilities for individual styling in its own right. Progress has been slow, but every now and then someone originates a new idea that moves vinyl along the road toward its own individualism.

Latest in this development is the pattern for Du Pont's breathable coated vinyl fabric designed by Russel Wright. Called Castleton, it has a unique duo-tone color texture which Mr. Wright designates as an "original." As it is turned in the light, different patterns form on the deeply textured surface. Likewise, a viewer, moving about a room sees the upholstery of a chair take on subtle changes in pattern.

Twenty furniture manufacturers have adopted Castleton for upholstery. When it is used on cushions, no venting is necessary. This means the cushion can be made reversible with one color on top and another on the bottom, thus doubling its wear life.

**Seating Comfort**—The breathable feature provides seating comfort since it will supposedly eliminate the complaint that non-porous elastomeric vinyl is hot. Officials did not state whether Castleton was a laminate or a spread-coated or calender-coated job, but pointed out that the breathable feature is obtained by a mechanical operation. Samples shown had a jersey backing, but it was stated that other types such as drill or sateen would serve just as well. The material is not recommended for outdoor upholstery since moisture might penetrate and cause mildew on the inner cushion.

Prospects that this material may soon be in a competitive position for use as automobile upholstery are bright, according to the producers. If that prediction comes true, there will be a merry struggle between all vinyl upholstery producers to get on the band wagon, for a successful, low-cost vinyl-coated breathable fabric will certainly create a tremendous impact on the market.

Only time will prove the practicality of this much-to-be-desired development in coated fabric. It is now difficult to foresee how this material can ever be produced at a comparable cost to conventional coated fabric, but if it proves satisfactory, the base market for vinyl-coated fabrics should be widely enhanced and the market for conventional coated fabric will be restricted.

### Large Polyethylene Rods

AVAILABILITY of extruded solid polyethylene rods as large as 6 in. in diameter and over 7 ft. long has been announced by H & R Industries, Nazareth, Pa. The stock is asserted to be non-porous and void-free.

Polyethylene sheet for punching and cutting purposes is also available, as well as polyethylene rods and tubes in a variety of diameters.

### Stokes Pipe Fittings

BACKLOG of orders for 1955 indicate that the Stokes Molded Products Div., The Electric Storage Battery Co., Trenton 4, N. J., will increase its sale of rigid P.V.C. pipe fittings by several hundred percent in 1955 over 1954, according to company spokesmen.

Officials admit that the 1954 volume was not monumental, but the company has been in the rigid P.V.C. field since 1951, are comparative veterans in the production of P.V.C. pipe fittings, and apparently believe that the day has come when rigid vinyl pipe and the necessary fittings to accompany it are defi-

# Here's Kralastic in window channels...

- practically friction-free
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- resistant to weather
- extremely tough
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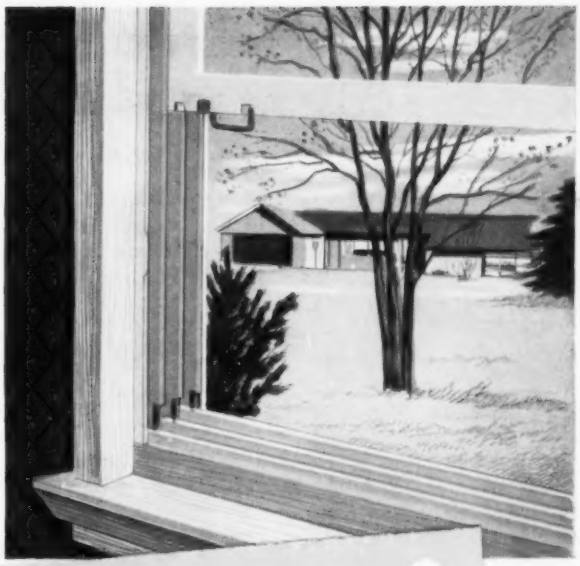

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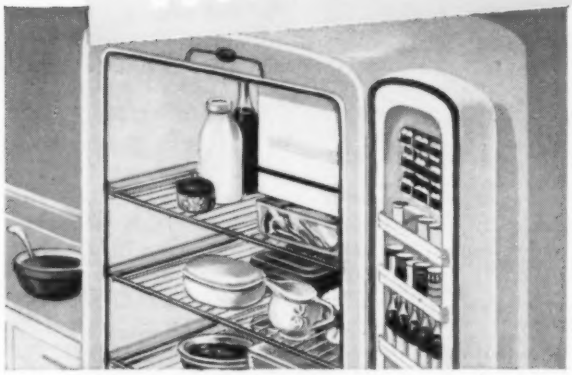
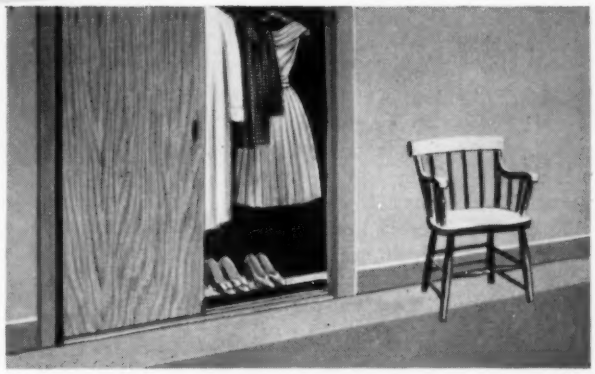


...refrigerator roll-out shelf channels



...door slides

Door slides and refrigerator slide rails of Kralastic would never stick or bind once properly installed. There'd be no rust or corrosion, never any need for painting, no warping out of shape. Doors would run smoothly, easily, quietly, *indefinitely.*

What's more, these Kralastic runners would be easy to install—readily sawed to length, drilled, nailed or screwed in place. Color would be permanent, too, *built in* so it couldn't flake, peel, or wear off.

And with Kralastic's great dimensional stability and self-lubrication properties, it allows a permanently snug fit to end banging or rattling from vibration.

Tough, versatile Kralastic rubber-resin recommends itself not only to these applications, but to hundreds more. With a combination of advantages no other material can match, it's already proved itself in pipe for brine, natural gas, and many chemicals—in lawn mower wheels, safety helmets, a host of really tough applications.

*See* what Kralastic rubber-resin can do for *you.* Write us today

Extruded Kralastic window channeling produced by Robert S Crane Associates, Columbus, Ohio.

Naugatuck Chemical

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nitely on the way up to sizable proportions. "Sizable proportions" means that several million pounds are expected to be used for rigid P.V.C. pipe in 1955.

The company gives no details on their method of production, but observers in the industry say that Stokes fittings are produced by compression molding P.V.C. rod or shaped forms.

Stokes states that improvement in resins is largely responsible for the growth in this section of the vinyl industry. The new resins are unadulterated with fillers and permit molding to close tolerances with no more than minor finishing operations. Even fully molded screw and bolt threads now are practicable.

### Polyesters for Isocyanates

PRICE reduction of 6¢ a lb. for special-grade polyester chemicals used in the manufacture of polyurethane foam has been announced by Mobay Chemical Co., 1700 S. 2nd St., St. Louis 4, Mo. These resins, which are combined with isocyanates to form polyurethane foam, will now sell for 59¢ a lb. compared to the previous price of 65¢ a pound.

The resins, called Multron R-18, and other special polyesters for combining with isocyanates, are now being manufactured by Mobay in Anniston, Ala., but a new full-scale production plant is being constructed in New Martinsville, W. Va., where both polyesters and isocyanates will be produced. Until now, the polyester has been imported from Germany.

### New Seal with Teflon

DESIGNED for complete interchangeability with stuffing box packing in pumps and other rotating processing equipment, Style WLZ Chempro wedge-lock mechanical seal, made with the stator bushing fabricated of zirconium-filled Teflon molded on pure Teflon, has been announced by Chemical & Power Products, Inc., 11 Broadway 4, N. Y. The new stator bushing is claimed to permit the seal to operate under slurry conditions that previously could not be sealed by a mechanical seal. It is also used for operations where carbon cannot be used because of the chemical properties of the material being pumped or mixed and will withstand temperatures up to 500° F.

### Phthalocyanine Blue for Green

INTRODUCTION of a new type of phthalocyanine blue pigment, which is claimed to offer no problems in formulation of green pigments, has been announced by Claremont Pigment Dispersion Corp., 110 Wallabout St., Brooklyn 11, N. Y.

Company spokesmen assert that green is a most difficult color to control, but that the green shades derived from phthalocyanine blue give excellent resistance to color change in mass-tone and tints in vinyl compounds subjected to processing temperatures for periods up to 60 minutes.

The material insures color uniformity and is available in both paste form and as a dry concentrate.

### Vinyl Wall Coverings

WALL coverings of vinyl film, sheeting, or coated fabric give promise of becoming one of the fastest growing segments of the vinyl industry. Progress, to date, has been slow, but recent developments certainly indicate that the market is opening up in a highly satisfactory manner.

Latest item in the field to be called to our attention is a new design for the Vicrtex line of coated fabrics manufactured by L. E. Carpenter & Co., Inc., 350 Fifth Ave., New York 1, N. Y. Called Shado-Star, the design is an original diamond pattern, in which each of the diamond shapes is striated in an alternate direction.

A booklet showing many of the patterns and color combinations available from the company may be obtained by writing to the address listed above. Carpenter first hit the market with its deeply embossed three-dimensional patterns several years ago and has been adding steadily to their variety since. Patterns simulating bamboo, grass weaves, linen, tweeds, and many other types of fabric design are available. The embossed material is, of course, equally as useful for upholstery as it is for wall covering.

Carpenter gives one particular note of warning for hanging its wall coverings. Starch or wheat pastes should not be used since vinyl does not breathe like canvas or paper. Consequently, the company has developed its own adhesives and is supplying them along with the wall covering.

This particular wall covering is now being used in department stores, hospitals, colleges, conference rooms, showrooms, hotel rooms, reception rooms, sun parlors, rumpus rooms, bathrooms, and kitchens. Vinyl's wearability, dirt resistance, and beauty are properties that equal or excel practically any other material used for wall covering purposes and as such make the material especially suitable for application where hard service is to be expected.

### Fiftieth Anniversary

OBSERVANCE of its 50th anniversary has been announced by Independent Die & Supply Co. The history of the company actually began in 1900 when The Independent Die Co. was founded by Carl Lindholm in Brockton, Mass. In 1905, Mr. Lindholm came West and started the present plant at 2641 La Salle St., St. Louis 4, Mo. Mr. Lindholm died in 1916 and the firm was taken over by Arthur W. Lindholm, vice president, and his two brothers, Carl F. Lindholm and Courtney R. Lindholm. Independent manufactures a complete line of cutting, perforating, and marking dies and employes 100 persons.

### Improved Impact Styrene Sheet

NOW available from Campco Div., Chicago Molded Products Corp., 2717 N. Normandy Ave., Chicago 35, Ill., in a wide range of thicknesses and colors is a rubber-modified styrene sheet (Campco S-540) of improved impact strength, fine texture, and exceptional freedom from strains.

According to the manufacturer, the sheet provides at least twice the impact strength of Campco's S-300 at no increase in cost.

In the thinner gages, from 0.010 to 0.030 in., Campco S-540 is avail-

stable colors for
POLYSTYRENE
Ferro Production Proved Dry Colorants will not change color, even at the high temperatures now used with heat-resistant polystyrenes, and are light stable. Solid or mottled colors in any shade may be prepared right in your plant. This means savings in raw materials, inventory, and in elimination of waste and scrap. You color only the amount of resin needed for each order. Write today for complete information.
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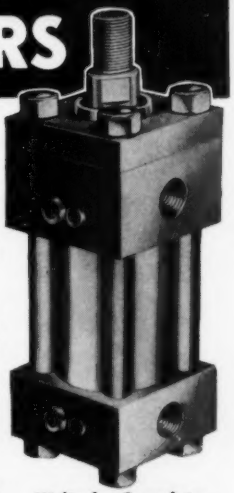

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# THE PLASTISCOPE

able with either matte or polished surface. The thinner gage sheets are supplied in widths up to 26 inches.

In the heavier gages, the material is available in thicknesses from 0.040 to 0.187 inch. The heavy-gage material can be supplied in matte, polished, or high-gloss finish with a luster comparable to that of porcelain enamel. The heavier sheets are available in widths up to 40 in. and are recommended for equipment housings, refrigerator parts, racks, trays, and similar applications.

### Twin Cities Chemical Association

OFFICERS of the Twin Cities Chemical Association, St. Paul, Minn., have been elected as follows:

President: William J. Fenelon, Hilex Co., Inc.

Vice president: Clifford P. Barth, Merchants Chemical Co.

Treasurer: Ted A. Wamstad, Mallinckrodt Chemical Co.

Secretary: Norman P. Anderson, Hawkins Chemical Co.

The Twin City organization is enjoying its second birthday. There are two types of members—resident and non-resident. Luncheon meetings are held on the third Monday of the month, and a cordial invitation is offered to all allied chemical people to attend.

### Quality Control

AN AGREEMENT on quality control to cover Harte & Co. Wataseal-Duxkin vinyl sheeting for use in outerwear garments has been signed by Harte & Co., 16 E. 34th St., New York, N. Y., and United States Testing Co., Inc., 1415 Park Ave., Hoboken, N. J. Points covered in the quality specifications are thickness, shrinkage, crocking, tensile strength, plasticizer volatility, cold crack, flexibility, flammability, seam strength, abrasion, spot resistance, and fastness to light.

In making the announcement, Fred S. Strauss, president of Harte, stated: "This certification of our product by United States Testing Co. is in addition to our own quality control program conducted in our laboratories. Product certification by an impartial independent laboratory gives added assurance of the maintenance of established standards and gives manufacturers further confidence in buying."

### Kralastic Window Tracks

SELF-LUBRICATING tracks that make possible a combination storm-screen window which can be opened or closed easily regardless of weather, have been developed by Robert S. Crane Associates, Columbus, Ohio.

The tracks, made of Kralastic, are rigid, smooth-surfaced, triple-grooved sections that fit into the window's metal frame. The window units slide up and down on the tracks without sticking or binding. The tracks are also flexible enough to give with any expansion in the metal of the window.

Several thousand windows with the new tracks have already been installed. Weather-Seal, Inc., Barberton, Ohio, manufacturer of the window, reports good performance and acceptance.

### Formaldehyde

HIGHER concentration formaldehyde is being produced by Nitrogen Div., Allied Chemical & Dye Corp., at new facilities recently placed in operation at its South Point, Ohio, plant where the company already produces methanol (raw material for formaldehyde) from natural gas.

The new facilities, utilizing a process developed in laboratories of Nitrogen Div., can produce formaldehyde in concentrations up to 50 percent. Formaldehyde was previously made at South Point in concentrations of 37 and 45 percent.

### Low-Temperature Plasticizers

DERIVED from soy bean oil, a new low-temperature plasticizer has been developed by Archer-Daniels-Midland Co., 700 Investors Bldg., Minneapolis, Minn. It is claimed that the plasticizer will help to produce vinyl chloride materials that will maintain flexibility at —40° C. and will not become brittle until temperatures drop to —55° C. The product is designed for use in raincoats, garden hose, automobile seat covers, and, according to the producer, can be used in government specification materials which require the use of plastics in the tropics as well as the arctic.

The company is doubling the capacity of its plasticizer plant in Decatur, Ill., to produce the new material.

Archer-Daniels-Midland also announces that Robert S. Mathews has been appointed manager of the company's newly formed Vinyl Plasticizer Dept. He has been with the firm since 1937. Edmund F. Vesely has been transferred to the new department and will serve as technical sales representative for Eastern markets. His headquarters will be at the company's New York office.

### New Silica Pigment

WHITE and almost chemically pure, a siliceous pigment is now being offered by Godfrey L. Cabot, Inc., 77 Franklin St., Boston 10, Mass., under the tradename Cab-o-sil. The company claims that it is different from all other silicas because it is made differently and is composed of particles so fine that one gram is said to contain 11 million billion particles. The product is economical because it is effective in small quantities.

Cab-o-sil is used in the plastics industry as a thixotropic, thickening, gelling, or anti-blocking agent. In the field of polyester-glass reinforced plastics, the silica acts as a thixotropic agent, resulting in less drainage of resin, greater uniformity of composition or thickness, and decreased raw material waste and production time. With the addition of only a small quantity of Cab-o-sil, a tremendous change in viscosity with shear of a polyester resin is obtained. About 10 lb. of the silica is used for 55 gal. of resin.

The product can also be used with epoxy resins to give the same thickening and thixotropic effects observed with polyesters. In general, 2 to 5% Cab-o-sil is required to prevent drainage.

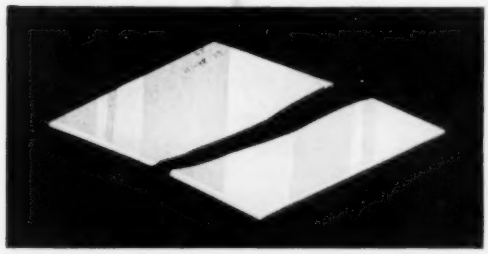
Cab-o-sil is also used to increase the thixotropic consistency of plastisols and organosols. A wider choice of plasticizers is possible since the flow properties of the plasticizer can be suitably adjusted. Films of about 40 to 50 mils in thickness can be ob-

# How tough is tough?

*See for yourself how Monsanto's Lustrex Hi-Test 88 takes punishing drop ball test!*

Thanks to an accurate measuring apparatus that drops a steel ball on test samples, the impact strength of Lustrex Hi-Test 88 styrene plastic is dramatically demonstrated!

Lustrex Hi-Test 88 can really take it! Just look how the steel ball bounces off the test sample, leaving it undamaged. *Compare this with the destruction of the general purpose styrene sample when the same ball was dropped from half the height.*



The same steel ball that left sample of Lustrex Hi-Test 88 undamaged (see left) split sample of general purpose styrene (above) when dropped from half the height.

In addition to outstanding impact absorption—actually five times greater than general purpose material—Lustrex Hi-Test 88 styrene has many other mechanical and molding advantages:

**Greater resistance to flexural fatigue**
**Improved flow characteristics**
**Greater total elongation values**
**Ideal for applications requiring lacquering**
**Suitable for injection and compression molding, extrusion and vacuum-forming**

Improve the quality and sales appeal of the products you mold. Try Lustrex Hi-Test 88 on your next job. Write Monsanto Chemical Company, Plastics Division, Dept. MP-4, Springfield 2, Massachusetts.

For superior toughness, specify

HI-TEST 88 LUSTREX Styrene Plastic

MONSANTO

# THE PLASTISCOPE

tained in a single dip with the use of a thixotropic plastisol or organosol, as contrasted with thicknesses of from a fraction of a mil to about 15 mils without the additive, according to Cabot technicians.

The new silica is now being evaluated in the company's research laboratories for its effects upon polyvinyl chloride, polyethylene, and polystyrene. At loadings of about 5% by weight, there is very little change in the optical properties of the plastics. At higher loadings, a slight haze develops.

### Plasticizer Price Reduction

PRICES of Flexol plasticizer A-26 (di [2-ethylhexyl] adipate) have been reduced 1¢ per lb. by Carbide and Carbon Chemicals Co. New prices are as follows: tank car lots, 42.5¢ per lb.; carload lots of drums, 44.5¢ per lb.; and less than carload lots of drums, 45.5¢ per pound.

Chief value of A-26 is its ability to impart excellent low-temperature flexibility and excellent light stability to vinyl chloride plastics, according to the company. As a dispersant for vinyls, it gives stable, low-viscosity plastisols.

### Slot Cell Wedges

TWO new widths of slot cell wedges, ¼ and $\frac{11}{32}$ in., making a total of five available sizes, have been added to the line of The Glastic Corp., 1823 E. 40th St., Cleveland 3, Ohio. The other sizes are $\frac{7}{32}$, $\frac{5}{16}$, and ½ inch.

The new Glastic channel wedges are fibrous glass reinforced, molded in one piece to shape and size. Used in Class B motors to replace asbestos, phenolic, and fish paper combinations, they are said to provide 100% Class B performance.

### New Boltaron Material

LOW-COST formable plastic sheet material called Boltaron 8100 is now available from Bolta Products, Div. of The General Tire & Rubber Co., Lawrence, Mass.

The material is reported to have impact strength ranging between that of modified styrene extruded sheets and styrene copolymer laminated sheets. It is designed for such applications as packaging units, point-of-purchase displays, bench assembly trays, refrigerator parts, business machine housings, and similar items requiring medium-impact strength.

### Price Reduction on Glass-Filled Compound

REDUCTION in the base price of Fiberfil Styrene-G from 67 cents to 55 cents a lb. has been announced by Fiberfil Corp., 2854 Sylvania Ave., Toledo 13, Ohio. The product, a fibrous glass-filled injection molding compound, is dimensionally stable, has high impact and high tensile strength, and has a heat distortion point of 220° F.

The company is also producing glass-filled nylon at prices varying from $1.60 to $2.00 a pound.

### Vinyl Foam

FULL production of Rubatex Gai-Foam, a vinyl foam material said to possess all the fine qualities of foam cushioning, plus important physical advantages, has been announced by the Rubatex Div., Great American Industries, Inc., Bedford, Va. The material is being produced under the Elastomer process in white utility stocks and will soon be marketed in choice of color and in slab utility, crowned utility, and molded cushions.

Morris Kaufmann Co. has been appointed exclusive sales representative for Rubatex Gai-Foam in the New York area.

### Plastic Aircraft Applications in England

SOME interesting things are being said in England these days about plastics in airplanes. An official inquiry report has soundly rejected a theory that the plastic adhesive, used for bonding metal parts of the pressurized cabin together, had failed and resulted in disaster to the jet transport Comets. The theory had been offered by one Bruno Jablonski, an aircraft components manufacturer, who was quoted in the press as stating that failure of the planes could have been caused by dissipation of the adhesive's strength due to swift temperature changes.

According to MODERN PLASTICS' information, the adhesive used was Redux, a phenolic-polyvinyl formal material invented by Aero Research, Ltd. in England and produced by Ciba Co., Inc.

Another interesting comment is that of Sir Arnold Hall, director of the Royal Aircraft Experimental Establishment at Farnborough who predicted that glass airplanes might fly from London to New York in 2 hr. 45 min. in future years. He said they would cruise at 1300 miles an hour—twice the speed of sound. He added that reinforced plastics at present are the only competitor in sight for aluminum as the material for building air frames and that such a fuselage would probably not only be cheaper but would be free from many of the problems of fatigue.

### Teflon Adhesive

A PRESSURE-SENSITIVE adhesive, which will bond Teflon to itself or to any other material, has a peel strength of 5 p.s.i. and a sheer strength of 25 p.s.i., according to an announcement by The Gilbreth Co., 1211 Chestnut St., Philadelphia 7, Pa.

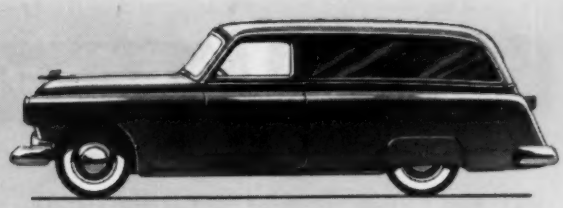
The company states that the product has exceptionally good adhesive properties for Mylar, silicone-glass laminates, polyethylene, and polyester film, as well as good dielectric strength, heat stability, and weather resistance.

### Hot-Spray Vinyl

VINYLS for application by spraying are no longer new, but their use and variety are spreading rapidly. Among the latest to come on the market is a hot-spray vinyl developed by Prufcoat Laboratories, Inc., 50 E. 42nd St., New York 17, N. Y.

Russ Hersam, general sales manager of Prufcoat, who won a Navy award for his efforts in helping to develop the vinyl cocooning process, says that the main objection to many vinyl applications of the spray type was the number of coats required to achieve necessary thickness. One of the principal advantages of the new hot-spray vinyl is that it gives an increased film build-up per spray coat and a significant reduction in overspray losses. The material will give more than 5 mils in a single

**From colorful and durable panels for delivery trucks to handsome television cabinets...**



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Ballistic panels
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Baskets for automatic washers
Wash tubs
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Kitchen containers
Fishing rods
Sinks
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Traffic signs
Fluorescent light fixtures
Television cabinets
Loudspeaker housings
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Structural panels for offices and homes
Door and transom lights
Awnings and canopies
Greenhouse panels
Skylighting
Molded chairs
Prefabricated houses and garages
Truck bodies

**COUNTLESS products benefit** from the combination of beauty and durability Pittsburgh SELECTRON Polyester Resins can give—and usually at reduced manufacturing costs.

**SELECTRON Resins are used** in products ranging from truck panels that withstand extreme hot and cold, rain, snow, and sleet to television cabinets that serve as focal points of beauty in homes everywhere.

**SELECTRON Resins are** thermo-setting polyesters which are available in consistency from a thin syrup to extremely high viscosity. They polymerize to form solids, with or without heat and with or without pressure.

**When combined with** such fillers as fiber glass, cotton, rayon, nylon, felt, sisal, paper, etc., SELECTRON Resins provide a new kind of material that is lighter than aluminum, yet—weight for weight—is stronger than steel. This material has great impact resistance and withstands the deteriorating influence of weather, sunlight, heat, abrasion and many chemicals. It can be molded in durable colors.

**Parts in which** SELECTRON Resins are used can be molded either by hand lay-up, direct molding, continuous lamination or pre-forming. These resins can also be used without fillers for casting, potting and impregnating.

**Investigate the advantages** of SELECTRON Resins that may make your products better looking, stronger and more durable. We'll be glad to have one of our engineers discuss your problems with you without cost or obligation. Such a visit may point the way to important production economies and added sales appeal.

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spray pass coat as compared to 2 mils per coat which is frequently the most satisfactory limit in cold spraying of regular vinyl. With multiple passes, the new Prufcoat hot spray can be applied in thickness from 10 to 15 mils without runs or sags.

Prufcoat hot-spray vinyl application is carried out at low fluid tank pressures of 15 to 20 p.s.i. as compared to the 40 to 50 p.s.i. pot pressure normally used in cold spraying, and at correspondingly lower atomizing pressures of 20 to 40 p.s.i.

Mr. Hersam contends that hot spray coats adhere better than cold and that shrinkage is reduced because of the lower solvent content. He maintains that his material saves time because fewer coats and faster application increase man-hour efficiency and decrease total cost per square foot of surface.

### Acrylate Monomer Prices

ANNOUNCEMENT of a price reduction of 4¢ a lb. for ethyl acrylate monomer and 1¢ a lb. for methyl acrylate monomer has been made by Rohm & Haas Co., Washington Sq., Philadelphia 5, Pa. The new tank car price, on a delivered basis, is now 38¾¢ a lb. for ethyl acrylate and 41¾¢ a lb. for methyl acrylate.

Rohm & Haas states that the reduction was made because of the lower costs resulting from higher volume production of its acetylene based process at the company's Houston, Texas, plant. This is the second price cut made since the plant started operation in January 1953.

### Custom Casting Service

ESTABLISHED by Applied Engineering Associates, 1952 Flushing Ave., Brooklyn 37, N. Y., a new service offers facilities for custom-casting end products from multi-component resin mixes such as ethoxylenes, polysulfides, polyamides, foamed phenolics, and polyurethanes. Applied Engineering will cast the finished products under production conditions which will enable the materials engineer, product designer, and sales department of any company to determine utility and customer acceptance of contemplated end products.

The service will be comparable to metal foundry shop operations for preparation of castings. The firm will produce finished parts to detailed specifications by its modified injection molding technique, utilizing inexpensive or expendable molds. It is reported that production cost analyses can be projected accurately.

### Polyethylene Blends

NOW commercially available are new polyethylene modifications, which are based on the original blends developed by L. A. Dreyfus Co., P.O. Box 500, South Plainfield, N. J., with the cooperation of producers of virgin polyethylene. The new Ladcote polyethylene-elastomer mixtures show great promise as extrusion-lamination paper coatings and as molding powders for tubing, gaskets, formed articles, and extruded wire coatings.

The company states that paper coated with these materials has improved moisture-vapor transmission-resistance, resistance to cracking, and adhesion to webs. Films from the polyethylene-elastomer blends are considerably stronger than those obtained from other modified polyethylenes. Reduced permeability to certain gases has also been noted.

Wire coated with polyethylene-elastomer blends is reported to demonstrate a greatly improved resistance to stress cracking.

Tubing, made from polyethylene-elastomer combinations, is in widespread use as a component of aerosol containers. Molded articles fabricated from such materials are more flexible, softer, and have a warmer feel than articles made from the unmodified base resin. Gasket materials from blended polyethylene have proved interesting to many users.

The original Ladcotes, combinations of high-molecular-weight polyethylene, wax, resins, and/or elastomers, have found wide acceptance in the paper coating industry. Ladcote materials are now in commercial use as coatings for multi-wall bag liners, pouch packages, barrier wraps, and freezer paper. Also available are Ladco thermoplastic adhesives for paper-to-paper and paper-to-polyethylene bonds.

The company also offers a custom compounding service, covering a broad range of thermoplastic materials. Polymers, waxes, and oils have been successfully modified to customer specifications.

### Koppers Trademarks

THE ENTIRE plastics line of Koppers Co., Inc., Pittsburgh 19, Pa., will now be marketed under tradenames instead of number designations as heretofore.

The company's general-purpose polystyrene will be marketed under the tradename Dylene. Expandable polystyrene, a foamable material that can be molded to any shape, will be designated as Dylite. Dylan is the new tradename for Koppers polyethylene. Styrene-butadiene latices, the ingredients in washable paints and paper coatings, will be tradenamed Dylex.

### Light-Stabilized Polyesters

AVAILABILITY of light-stabilized and of very light-colored polyester resins has been announced by Bakelite Co., a Div. of Union Carbide and Carbon Corp. The new resins are designed to minimize color fading and maintain favorable light transmission in structural panels of reinforced plastic for skylights, greenhouses, factories, carports and patio roofs.

Designated as PLLB-5003 Natural, the light-stabilized resin resists color fading under direct sunlight in such uses as industrial glazing, decorative window panels, outdoor partitions, and porch and terrace roofs. Bakelite's polyester resin PLLA-5006 Natural has the same light color and other favorable characteristics as PLLB-5003 and is recommended for fabricators who wish to add their own light-stabilizing agent.

## EXPANSION

**Koppers Co., Inc., The Firestone Tire & Rubber Co.**, and certain Brazilian interests have joined in forming a new company which will construct and operate a styrene mono-

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mer plant in Cubatao, Brazil. Under the name of **Companhia Braziliera de Estireno** (Brazilian Styrene Co.), plans are underway for the erection of a plant capable of producing 10 million lb. of styrene monomer annually. The production will go mainly to Brazilian manufacturers of polystyrene, while a lesser portion will go into the production of styrene latices and high styrene polymers, such as are used in the manufacture of shoe soles.

Koppers and Firestone will have slightly more than 50% interest in the new company. Brazilian interests include **Companhia Braziliera de Plastico,** a polystyrene manufacturing firm in which Koppers has had an interest since 1950.

**George M. Walker,** vice president and general manager of Koppers' Chemical Div., and **Lee R. Jackson,** president of Firstone, state that the newly formed Brazilian firm has been granted a loan of $2.5 million by the Export-Import Bank to apply on United States dollar costs involved in construction of the plant. Actual costs will be considerably in excess of this figure, they assert, and the remaining financing is to be effected by the sale of stock to the partners.

The new plant will use ethylene from an adjacent government-owned refinery, and benzene. The latter will be imported.

**Goodyear Aircraft Corp.,** Akron 15, Ohio, has installed five heavy presses designed to form reinforced plastics products. The presses range in size from 100 to 700 tons. The first job for the 700-ton press will be production of one-piece hulls for outboard boats to be marketed by Bowman, Inc., Little Rock, Ark.

The company claims that its overall facility for reinforced plastics products is perhaps the largest installation of its kind. The equipment required a year to install.

**American Resinous Chemicals Corp.** announces the completion of a remodeling program for its laboratories in Peabody, Mass. The new laboratory area includes provision for work on resin and plastic emulsions, solutions, and hot melts; a constant temperature room; special work areas for solvent adhesives and coatings that contain pilot plant processing and churning equipment; a sample room; and a conference room.

In addition to regular compounds for the textile, plastics, paper, rubber, automotive, and floor covering fields, the company develops special adhesives or coatings for specific customer uses.

**Midwest Molding & Mfg. Co.** has moved its sales and executive offices from 4630 W. Fullerton Ave., Chicago, to its plastics molding plant in Gurnee, Ill., 35 miles north of Chicago, just west of Waukegan.

As part of an expansion and remodeling program started in 1946, the company added injection molding to its tooling, compression, and transfer molding facilities and has maintained the Chicago office and plant for inspection and service.

Midwest was established in 1933. For many years the firm has been a volume supplier of molded brush caps, brush holders, and commutators to electric motor and appliance manufacturers. In addition, Midwest produces custom molded plastics units and components for a variety of uses.

**National Starch Products,** 270 Madison Ave., New York 16, N. Y., announces a $3,500,000 expansion program to provide the following improvements: new and modernized equipment at the Plainfield, Chicago, and San Francisco plants to improve adhesive manufacturing facilities; expansion and modernization of the Indianapolis plant, which will increase the present starch grind; doubling the size of the company's Alexander Research Laboratory, Plainfield, N. J., to consolidate and coordinate all technical and research efforts in the East; and equipment to permit more efficient manufacture of the many new resin products introduced in the past several years.

National Starch has recently placed a contract with **Blaw-Knox Co.,** Pittsburgh, Pa., to erect a second plant in Meredosia, Ill., for the manufacture of vinyl acetate polymers and copolymers. The plant is scheduled for operation this summer.

**L-O-F Glass Fibers Co.,** Toledo, Ohio, recently formed by the merger of Glass Fibers, Inc. into the former Libbey-Owens-Ford subsidiary, began operations in March.

Officers of the new company are as follows: **George P. MacNichol, Jr.,** president of Libbey-Owens-Ford Glass Co., has been appointed new chairman of the board; **Randolph H. Barnard,** former president and chief executive officer of Glass Fibers, which he founded in 1944, is president and general manager; and **Thomas A. Collins,** previously executive vice president of Glass Fibers, has been named vice president and assistant general manager. **Curtis W. Davis** will be in charge of production and **J. M. Johns** has been appointed director of sales.

The new L-O-F Glass Co. will have total assets of $14,484,122, divided into $7,674,537 from the former L-O-F subsidiary and $6,809,586 from Glass Fibers, Inc.

**The Brittain Products Co.,** Cuyahoga Falls, Ohio, is moving into a larger, more fully equipped plant. The company was organized in 1947 for the manufacture of plastics products, particularly premiums.

Included in the expansion program, costing about $150,000, are a new building and facilities for vacuum forming of plastics materials. Brittain Products is already equipped to make dies for, and to manufacture, many types of plastics products.

**P. W. Brittain,** president, states that with the addition of the new facilities, his company will be able to take a self-liquidating premium in "idea form" and handle it throughout all stages of design, development, manufacture, and distribution.

**Strick Co.,** Philadelphia, Pa., announces the opening of a new $250-000 plant in Perkasie, Pa., for the manufacture of fibrous glass reinforced plastics products. The plant will be operated by a subsidiary, **Strick Plastics Corp.** The parent company, manufacturer of truck trailers, has also produced reinforced plastics for some time.

The new plant will specialize in the manufacture of Daycor sheets for awnings, patios, skylights, and

(*To page* 268)

*Trade-mark

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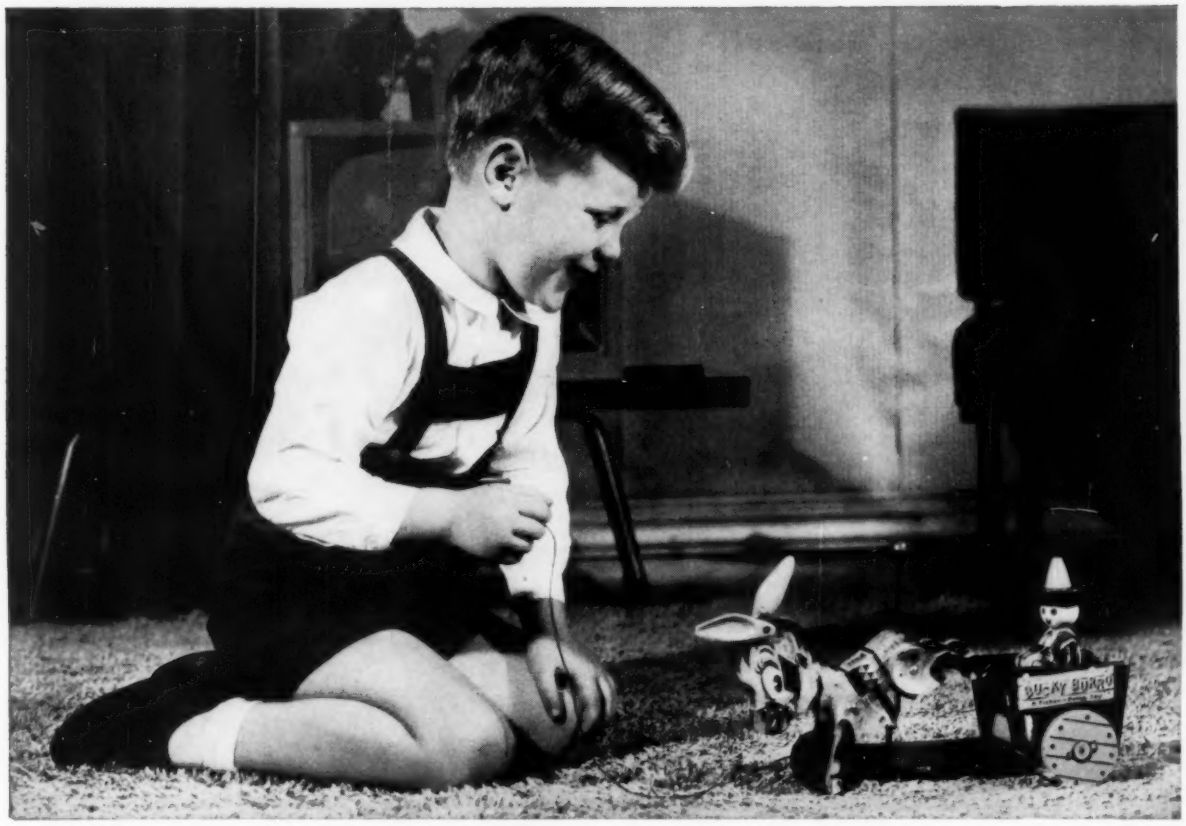
## FOR TOYS ON THE MOVE...




**BUCKY BURRO**—Hercocel acetate ears flip back and forth; spring tail swishes as burro bucks up and down with realistic kicking motion; life-like "hee-haw, hee-haw" sound intrigues every child.

**DONALD DUCK**—Hercocel acetate feet revolve with laughable "flip-flop" action on this most realistic Donald Duck in pull toy history; ingenious voice mechanism sounds just like Donald himself; arms swing in unison with feet and legs. Both toys manufactured by Fisher-Price Toys, Inc., East Aurora, New York. Hercocel parts molded by Trimold, Inc., Kenmore, New York.

Two of the newest and most ingenious pull toys to come off the Fisher-Price production line, this Donald Duck and Bucky Burro promise new counter appeal and profits for smart retailers. A clever combination of lithographed wood and super-tough Hercocel plastic, they've got color . . . action . . . sound . . . and the durability that keeps both children and their parents happy.

There's greater play value and longer play life in toys when parts are molded from Hercocel—Hercules® cellulose acetate, a safe and enduring plastic. And manufacturers find that Hercocel's toughness cuts losses in assembly, shipment, and display. From plant to purchaser, Hercocel truly *keeps toys on the move.*

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**HERCULES POWDER COMPANY**
INCORPORATED
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**IS POINT BLUNT?**

♦ P-K Type A Sheet Metal Screws have sharp gimlet points. Start easy, drive straight, even when holes in two sheets are misaligned.

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*. . . in assembly savings*

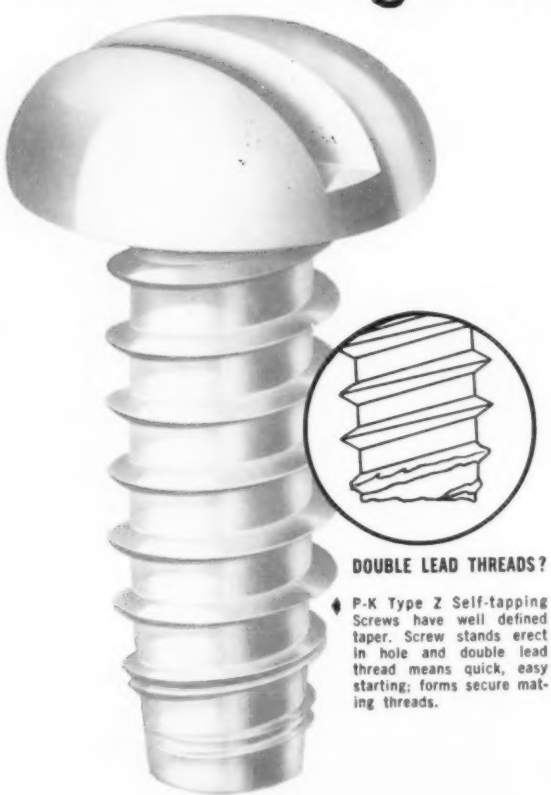
# the **POINT** makes the difference

A properly planned saving of 15 cents per unit can fade to 1½ cents — or nothing — on the assembly line . . . unless the screws you use have the good points that assure quick starting and straight driving.

Bad points are hard to detect in the package, but your cost sheets and customer complaints will soon show their effects — job slowdown, parts spoilage, hidden weakness.

That's why P-K quality standards have been set so high — to make sure you get P-K Self-tapping Screws that are not only *pointed for savings*, but headed, threaded, and heat-treated with one purpose, to keep your assembly lines trouble-free.

Start making *planned* assembly savings pay off . . . talk to a P-K Assembly Engineer. Parker-Kalon Division, General American Transportation Corporation, 200 Varick St., New York 14.



**DOUBLE LEAD THREADS?**

♦ P-K Type Z Self-tapping Screws have well defined taper. Screw stands erect in hole and double lead thread means quick, easy starting; forms secure mating threads.

**PARKER-KALON®**

**IN STOCK . . . see your nearby P-K Distributor . . .**

**HOW MANY FLUTES?**

P-K Type F Screws have **five** thread cutting flutes; easier to start, less torque to drive, cut clean threads all the way in.

*per unit*

## P-K STANDARDS
**make sure you get**
## SCREWS POINTED FOR SAVINGS

P-K design and quality standards protect you against the bad points shown and many others that will slow down assembly and cause parts damage. They don't "get by" P-K Inspectors — that's why *all* P-K Self-tapping Screws can be "Guaranteed First Quality."

**IS PILOT TOO SHORT?**

Pilots of P-K Type U Drive Screws are proper size and length to permit screws to start straight, drive straight.

*The First* **originated by P-K . . . and First today . . . the leading choice for fastening economy**

# SELF-TAPPING SCREWS

**your local Supply and Service Specialist**

# THE PLASTISCOPE

bath enclosures, as well as Lamicor panels, a form of reinforced fibrous glass especially made for industrial use. About 100 persons will be employed in the plant.

**Kennedy Car Liner & Bag Co., Inc.,** Shelbyville, Ind., has purchased **Justice-Doyle Co.,** Jefferson, Ind., and moved the entire assets of the firm into one of the parent plants in Shelbyville. Justice-Doyle manufactures polyethylene bags.

**Martin Justice,** former president, will join Kennedy's production staff. Among his accomplishments are the development of a process for printing polyethylene tubing on both sides and a process for executing a waterproof seal on polyethylene bags that is free from pin-holes.

**OlsenMark Corp.,** manufacturer of the Kensol line of roll leaf stamping equipment, has acquired additional space at 124-32 White St., New York, N. Y.

## COMPANY NOTES

**Du Pont** announces the following appointments in its Film Dept.: **Daniel D. Lanning** has been named manager of sales development and technical service, with **Whitney G. Hunter** as associate manager. **Dr. John P. Wilkins** succeeds Mr. Lanning as assistant manager in charge of sales development activities and **Mac L. White** replaces Dr. Wilkins as supervisor of sales development. **Richard A. Sutherland** has been appointed supervisor of a recently formed end-use research group. Mr. Lanning joined Du Pont in 1934 as an operator at the Old Hickory, Tenn., cellophane plant.

**B. F. Goodrich Chemical Co.,** Rose Bldg., Cleveland, Ohio, has appointed three new plastic product sales managers as follows: **W. D. Lahey** has been named manager of extrusion and molding materials; **E. B. Osborne,** manager of calendering and coating materials; and **H. L. Wuerth,** manager of wire and cable materials. They will report to **G. A. Fowles,** manager of plastic materials sales. All three appointees, former sales representatives, have moved into the Cleveland area from BFG Chemical offices in other states. Mr. Lahey came from Chicago, Mr. Osborne from Philadelphia, and Mr. Wuerth from New York City.

Mr. Lahey joined the company in 1945 as a chemical engineer in Cleveland and has worked in New York and Chicago since then as both a technical and sales representative. Mr. Osborne came to the parent organization in 1943. He started the operation of the BFG Chemical branch office in Philadelphia in 1952. Mr. Wuerth, formerly with Anaconda Wire & Cable Co., joined BFG Chemical in 1946 as a technical service engineer on wire and cable covering. He was transferred to New York as a sales representative in 1947.

**Koppers Co., Inc.,** Pittsburgh 19, Pa., announces that **Dr. E. W. Volkmann** has been named manager of the Research Dept. and will be responsible for the coordination of all Koppers research, including works at its Verona, Pa., Research Center, and elsewhere in the country. **Dr. A. R. Powell,** who has been acting manager of the department, has been appointed special research adviser.

**National Vulcanized Fibre Co.,** Wilmington, Del., has retained **Donald Deskey Associates,** 630 Fifth Ave., New York, N. Y., industrial design consultants, to conduct a long range program of product research and development. The Deskey organization has been assigned the job of exploring the many new product possibilities of vulcanized fibre, as well as redesigning existing products made from this material.

**Acheson Industries, Inc.,** 420 Lexington Ave., New York 17, N. Y., announces that **M. W. Reynolds** has been appointed general manager of Acheson Colloids Div. and **P. C. Buck** named to take charge of engineering and production of Acheson Industries. Both appointees are vice presidents of Acheson Industries. Mr. Reynolds will have full responsibility of the Port Huron, Mich., operation, formerly shared by Mr. Buck. Mr. Buck's position is a new one, growing out of the company's recent expansion. He is currently in Orange, Texas, supervising construction of a new pigment dispersing plant for Acheson Dispersed Pigments Co., Philadelphia, Pa., and will return to Port Huron to carry on his new assignment.

**J. S. Thome,** vice president of Acheson Dispersed Pigment Co., announces the appointment of **Morgan Jones** as plant manager of the new subsidiary in Orange, Texas.

**Celanese Corp. of America,** 180 Madison Ave., New York 16, N. Y., has made the following appointments in its Chemical Div.: **Robert H. Kampschulte** has been named general sales manager, succeeding John W. Stevens who has resigned. Mr. Kampschulte joined the company in 1947 and has been assistant general sales manager since 1952. **Robert J. Davis** has been appointed supervisor of the sales development group; **Howard L. Pilat,** supervisor of the new chemical development group; and **Winthrop M. Barnes,** supervisor of market research.

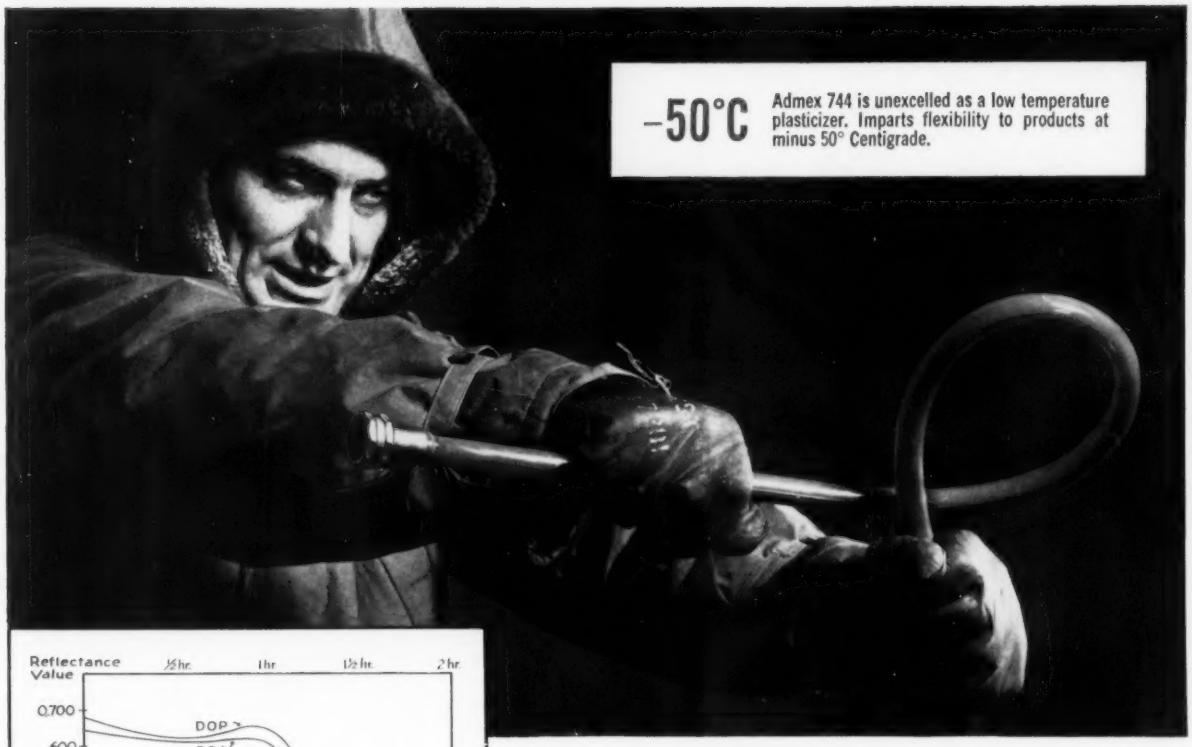
**Automotive Rubber Co., Inc.,** announces that **R. P. Ganchan** has been transferred from the Houston, Texas, plant to the Detroit, Mich., administrative offices as a vice president and general manager of the company. Automotive Rubber is engaged in the rubber tank lining industry but is currently interested in the development of molded closed-cell polystyrene uses.

**Continental-Diamond Fibre Co.,** Newark 29, Del., announces that its directors have formally approved a proposal of Budd Co. to purchase all its assets and assume its obligations by delivery of 450,000 shares of $5 par stock of Budd Co. The plan will be submitted to stockholders. Continental has 450,000 shares of stock.

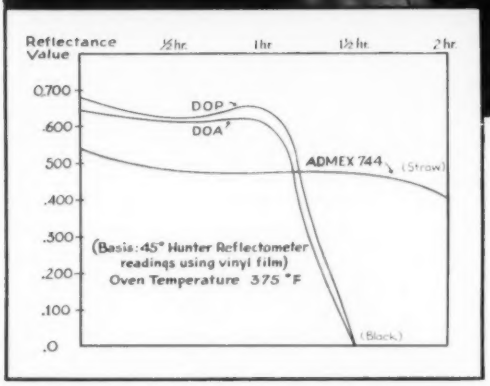
**W. S. Shamban & Co.,** 11617 W. Jefferson Blvd., Culver City, Calif., has been appointed distributor of Teflon-coated glass fabrics manufactured by Du Pont.

**Bestway Products, Inc.** has moved its manufacturing facilities to a new and larger plant located on Globe Ave., Mountainside, N. J.

**Textileather Div., The General Tire & Rubber Co.,** Toledo 3, Ohio, announces the following promotions in its Sales Dept.: **Thomas P. Bargmann** has been named assistant sales



**−50°C** Admex 744 is unexcelled as a low temperature plasticizer. Imparts flexibility to products at minus 50° Centigrade.




**+375°F** Admex 744 demonstrates excellent heat and light stability, withstanding processing temperatures as high as 400° Fahrenheit.
Test formulation upon request

## Specifications

| | |
|---|---|
| Acid Value | 1.0 max. |
| Color (Gardner) | 3.0 max. |
| Viscosity @ 25° C. | 0.5 Stokes max. |
| Refractive Index | 1.4512 approx. |
| Specific Gravity @ 25° C. | 0.909 approx. |
| Weight per gallon | 7.56 lbs. approx. |

# Newest epoxy-type plasticizer offers remarkable advantages at extreme temperatures

Think of it! Vinyls made with Admex 744 are flexible at temperatures below minus 39° Centigrade, where mercury solidifies. In addition, they have outstanding stability at high processing temperatures.

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manager; **Lester F. Naylor** has become branch manager and will serve the southeastern states; and **Richard Nutt** has been appointed product manager for furniture upholstery and allied products.

**Atlas Electric Devices Co.** has moved to its new plant at 4114 N. Ravenswood Ave., Chicago 13, Ill. The plant provides the company with expanded facilities for research and manufacturing of Fade-Ometers, Weather-Ometers, Launder-Ometers, Atlas scorch testers, and Atlas accelerators.

**The Crookshank-Cleveland Co.,** 7500 Stanton Ave., Cleveland, Ohio, has been set up as manufacturers agents. The proprietor is **Don Crookshank,** who was formerly affiliated with The Richardson Co. as Cleveland district manager, The Vlchek Tool Co.'s Plastics Div. as sales manager, and the Nu-Bone Co.'s Plastics Div. as sales manager.

**Victory Mfg. Co.,** 1720 W. Arcade Place, Chicago, Ill., quarter-century-old plastic molder, wishes to make known the fact that it has no connection with **Victory Plastics Co.,** Hudson, Mass., which has announced that it is discontinuing the manufacture of plastics housewares. On the contrary, the Victory firm in Chicago has recently added considerable floor space and several new pieces of equipment to help increase the company's production of housewares, toys, and other plastics items.

**Permagile Corp. of America,** 300 Fourth Ave., New York 10, N. Y., a new affiliate of **American Agile Corp.,** announces that **Dr. Theodore I. Leston** has been named vice president and **William B. Kriewall** vice president in charge of research, development, and production.

The new corporation has plants in Cleveland, Ohio, and Long Island, N. Y., and will manufacture, distribute, and sell the Permagile compounds. The compounds are especially designed for sealing and welding many dissimilar non-metallic materials.

**T. V. Jay Co.,** 4429 N. Kilpatrick Ave., Chicago, Ill., has established a mold department capable of making injection, compression, and vacuum

forming molds by the electroforming process. The molds can be made from plastic models and are available in pure nickel for long runs and chrome-plated copper for short runs.

The company also reports that it is equipped to make models, which are needed in the electroforming process, direct from blueprints. Molds, both for short and long runs, are now in production in molding plants in the Midwest.

**Waldon, Inc.**, 919 N. Michigan Ave., Chicago, Ill., has expanded its facilities for the manufacture of electroformed paint spray masks for plastic finishing. The masks are made of either solid nickel or copper, nickel-plated for long life, ease in cleaning, and maintenance of accuracy.

**Anawan Plastics & Machine Corp.**, 22 Boomer St., Fall River, Mass., has been recently formed and will produce containers of all descriptions from fibrous glass, as well as from high-impact copolymer plastics. **Hugh Neville, Jr.**, formerly vice president and sales manager of Laminex Corp., Fall River, has been named president of the new firm.

**Standard Insulation Co.**, East Rutherford, N. J., announces the appointment of **Tracy Cowen** as assistant general manager and **Dr. Alex Sacher** as technical director of the company. Mr. Cowen was formerly affiliated with Standard Packaging Corp.'s General Felt Div. as vice president in charge of sales. Dr. Sacher was recently assistant director of coating research and development of Irvington Varnish & Insulator Div., Minnesota Mining & Mfg. Co.

**Rampe Mfg. Co.**, custom molders at 3320 St. Clair Ave., Cleveland 14, Ohio, formerly a partnership, has been incorporated.

Officers of the firm are **John F. Rampe**, president and treasurer; **W. Charles Rampe**, vice president; and **Paul A. Rampe**, secretary.

**Cropp Engineering Div., Warren Plastics Corp.**, Warren, Pa., has named **The Rainville Co.**, 53 Hilton Ave., Garden City, N. Y., national sales agent for its rotary automatic compression molding press.

**R. M. Hollingshead Corp.**, Camden, N. J., reports the following appointments: **George F. Sharrard** has been named manager of the Technical

"It was Mike who suggested: 'Make money by using A. Bamberger's **reprocessed pellets** of guaranteed quality.'"

The idea is simple . . . and sound. You get guaranteed quality with A. Bamberger's reprocessed materials. The only difference is *they cost you less.* And that means extra sales and profits any way you figure it. And how about turning your plastic scrap into cash? You'll get top prices for surplus virgin inventory, off-color molding powder, obsolete parts . . . scrap that's idling and eating up space. Call us in. Send samples, or let us inspect.

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*PLASTICS MATERIALS*

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Service Div. **William L. Carolla** has been appointed industrial manager and **Paul W. McDonald** regional sales manager of the Western Div. at the firm's new Sunnyvale, Calif., plant which is nearing completion. Mr. Carolla will be in charge of sanitary maintenance products, Cocoon sprayable plastics protective coatings, and aviation chemicals. Mr. McDonald will supervise the company's sales activities in 10 western states.

Hollingshead also announces the opening of a regional sales office at 22 E. 40th St., New York, N. Y. **H. Wilson DuVal** will be regional sales manager of the new office.

**Bartrev, Ltd.** has appointed **Bramco, Inc.**, 626 Fifth Ave., New York 20, N. Y., to handle its sales of the Bartrev continuous press in the United States. **L. R. Louis**, formerly sales director of Aries Fiberboard Corp., will be vice president in charge of sales of Bramco.

**Bedford-Bolling Co.**, successor to Bolling & Son, has recently been incorporated to take over the used machinery business of the parent company, **Stewart Bolling & Co., Inc.**, Cleveland, Ohio.

The company also announces that a new plant will be constructed on a tract of land in Bedford, Ohio.

**Radio Receptor Co., Inc.**, 240 Wythe Ave., Brooklyn, N. Y., announces the election of **Hugo Cohn** as president and **Harold R. Zeamans** as secretary-treasurer of the company. Mr. Cohn succeeds **Ludwig Arnson**, who has retired from the presidency, a post which he had held for 31 years. Mr. Arnson will continue to serve the company as a director and consultant. Mr. Cohn was formerly executive vice president of the firm.

**Commercial Plastics & Supply Corp.**, 630 Broadway, New York 12, N. Y., announces the establishment of a branch office and warehouse at 449 W. Flagler St., Miami, Fla., under the management of **Joseph E. McCabe** and an office at 1039 Westside Dr., Greensboro, N. C., to be supervised by **George Tonkin** and **George Schiffer. Donald I. Yarnall**, formerly associated with Rohm & Haas Co.'s Sales Dept. for 20 years, has been named general manager of the company.

**Casware, Inc.**, 294 Madison St., Wilkes-Barre, Pa., has appointed **Northeast Co.**, Second National Bank Bldg., 15 W. Market St., Wilkes-Barre, as its sales representative to handle Casware products in three eastern states. **Karl A. Remcho** will be in charge of sales and promotion of the Northeast firm.

## PERSONAL

**Herbert S. Spencer**, advertising director of **Durez Plastics & Chemicals, Inc.**, North Tonawanda, N. Y., has retired under the company's pension plan and will handle several accounts as advertising and sales consultant. Mr. Spencer joined the Durez organization in 1926 and was one of the pioneer developers of new markets for plastics and the use of plastics as a packaging material. He was one of the organizers of S.P.I. and served two terms as director. Mr. Spencer was also responsible for the founding of the Plastics Pioneers Association and was its first president.

**D. N. Phillips** has been named assistant manager of the **Molding Materials Sales Div., Bakelite Co.**, 260 Madison Ave., New York 16, N. Y. Associated with plastic molding materials since he joined Bakelite in 1939, Mr. Phillips has been affiliated with the New York sales office since 1941.

**Ernest K. Hunt** has been named public relations manager of **American Cyanamid Co.**, 30 Rockefeller Plaza, New York 20, N. Y. He was formerly advertising manager of the Organic Chemicals and Pigments Divisions.

**Philip Golbin** has been elected secretary-treasurer of **Luria-Cournand, Inc.**, Havre de Grace, Md., fabricator of structural plastics. For the past four years, Mr. Golbin was controller of E. L. Cournand & Co., Inc., which became Luria-Cournand, Inc. under a refinancing and recapitalization plan that went into effect a few months ago. He was also controller of Lanvin Parfums, Inc., New York, N. Y., during the same period.

**J. Joseph Kelly** is now sales manager of **Reed-Prentice Corp.**, Worcester 4, Mass., an affiliate of **Package Machinery Co.** Mr. Kelly was formerly field sales manager of the parent company.

**Henry Groppe** has been appointed assistant director of research-development of **Monsanto Chemical Co.'s Plastics Div.**, Springfield, Mass. He has been with the company since 1950 as a member of the development department.

**Homer Buckelmueller** has been appointed eastern sales engineer of **H & R Industries**, Nazareth, Pa. Mr. Buckelmueller was formerly associated with The Garrison Co., Gering Products, Inc., and Industrial Synthetic Corp.

**Alander F. Hogland** has joined **Electronic Processes Corp.**, Los Altos, Calif., manufacturer of high-frequency and impulse-heat-sealing equipment for plastic processing in the manufacturing and packaging fields.

**Marvin M. Kahn** has been promoted to director of development for new products of **Acme-Hamilton Mfg. Corp.**, Trenton 3, N. J. Mr. Kahn has done development work on both rubber and plastics hose and has assigned patent rights on a new type of plastic hose to the corporation.

**John Marzulli** has been appointed vice president of plant operations of **Harte & Co., Inc.**, 16 E. 34th St., New York 16, N. Y. He joined the engineering department of the plant in 1946 and became plant manager three years later.

**Edwin W. Lynn** has been named product development manager of **Celluplastic Corp.**, 50 Avenue L, Newark 5, N. J.

**Earl Erich** has joined the technical service staff of **Tube Turns Plastics, Inc.**, Louisville, Ky. Mr. Erich specializes in industrial corrosion problems. He began his career as a research chemist with The Atlas

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*for plastics filaments with ALQUIST winding units.*

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Mineral Products Co. and later organized and headed that company's Thermoplastics Div.

**Dr. Irving Skeist** has established a chemical consulting service at 14 Edgar St., Summit, N. J. A registered patent agent and author of patents and publications on plastics and polymers, Dr. Skeist was formerly associated with Celanese Corp. of America, Newark Paraffine & Parchment Paper Co., American Molding Powder Co., and Gering Products, Inc.

**Gordon R. Porterfield** has been appointed New York district representative of **Elmes Engineering Div., American Steel Foundries**, Cincinnati 29, Ohio. The company manufactures hydraulic presses and equipment.

**F. C. Wehrman** has been appointed New England technical sales representative of **Standard-Toch Chemicals, Inc.**, Staten Island, N. Y., and Chicago, Ill. Mr. Wehrman will service eastern Massachusetts, Rhode Island, New Hampshire, and Maine. The company manufactures organic finishes.

**John G. Penniman** is now manager of the newly created **Emulsion Div.** of **Reichhold Chemicals, Inc.**, 525 N. Broadway, White Plains, N. Y.

**Albert Safianoff** has been appointed director of research and product development of **Federal Tool Corp.**, 3600 W. Pratt Blvd., Chicago 45, Ill. Mr. Safianoff was formerly connected with Victory Mfg. Co.

**Charles H. Frantz** is now executive director of new product development of **Chicago Molded Products Corp.**, 1020 N. Kolmar Ave., Chicago, Ill. He was formerly affiliated with Plastic Mfg. Co. as works manager and Kurz-Kasch, Inc. as general manager.

**Ben Carroll** has been named research director of **Furane Plastics, Inc.**, 4516 Brazil St., Los Angeles 39, Calif. Mr. Carroll was formerly research chemist at the laboratory of the National Bureau of Standards engaged in high-temperature dielectrics studies and general casting resin evaluations. More recently, Mr. Carroll was associated with Sandia Corp.'s Organic Materials Div., where he was active in the development and processing of casting, laminating, and molding materials.

**Joseph V. Delaney** has been named general manager of **Columbia Div., The Lodge & Shipley Co.**, Hamilton, Ohio. He has been with the subsidiary since 1942 and served as controller. Mr. Delaney is also a director of Lodge & Shipley. He succeeds **John R. Queen** who resigned to join **Globe Hoist Co.**, heading a new plant in Long Beach, Calif.

**Warren E. Peterson** has joined **Spencer Chemical Co.**, Kansas City, Mo., as the firm's New York sales representative.

**Thomas P. Brown** is now vice president of **Scientific Design Co., Inc.**, 2 Park Ave., New York 16, N. Y., and will be in charge of new project developments. He was technical vice president of Reichhold Chemicals, Inc. for 15 years. Scientific Design specializes in the design and engineering of organic chemical processes and plants.

**Arthur E. Gabriel** has been appointed research project leader of **Evans Research & Development Corp.**, 250 E. 43rd St., New York 17, N. Y. Mr. Gabriel, formerly with Armour Research Foundation of Illinois Institute of Technology, is a member of the Adhesives Subcommittee of the American Society of Testing Materials. He has also carried on research and development in resins, laminates, rubber, adhesives, coatings, plastics, and paints at Ellis-Foster Co., American Hard Rubber Co., and the U. S. Forest Products Laboratory.

### Deceased

**James L. Rodgers, Jr.** died in New York at the age of 58. Following his managership of a sugar plantation in Cuba in the early 1920's, Mr. Rodgers joined Plaskon Co., Inc. and was president of that firm from 1929 to 1943. After that company's absorption by Libbey-Owens-Ford Glass Co., he was vice president of the latter company from 1943 to 1947. Mr. Rodgers subsequently served as general manager of American Cyanamid Co.'s Plastics and Resins Div. from 1948 to 1953. He was a former president of the Plastics Materials Manufacturers Assn. and a founder and member of S.P.I. Mr. Rodgers was one of the leaders in the organization of the plastics research program of Massachusetts Institute of Technology.

## MEETINGS

**April 4-5**—American Institute of Electrical Engineers, Plastics and Rubber Conference, Mayflower Hotel, Akron, Ohio.

**April 4-7**—American Chemical Society, Div. of Paint, Plastics, and Printing Ink Chemistry, Cincinnati, Ohio.

**April 13-15**—The Society of the Plastics Industry, Inc., S.P.I. Pacific Coast Section Conference, Palm Springs, Calif.

**April 16-17**—Packaging Machinery Manufacturers Institute, Semi-Annual Meeting, Palmer House, Chicago, Ill.

**May 1**—American Institute of Chemical Engineers, Meeting, Shamrock Hotel, Houston, Texas.

**May 7-15**—The Society of the Plastics Industry, Inc., 1955 Annual Conference, Convention Cruise aboard *Queen of Bermuda* to Havana, Cuba, and Nassau, B.W.I.

**May 14-22**—ACHEMA XI, Chemical Plant and Apparatus Exhibition and Congress, Frankfurt am Main, Germany. Sponsored by Deutsche Gesellschaft fur Chemisches Apparatewesen (DECHEMA). Additional information may be obtained from the Chicago Section of the American Chemical Society, 86 E. Randolph St., Chicago, Ill.

**May 18-19**—The Chemical Market Research Association, Annual Meeting, Hotel Plaza, New York, N. Y.

**June 1-11**—British Plastics Federation, British Plastics Convention and Exhibition, National Hall, Olympia, London, England. Applications for tickets should be made to British Plastics Exhibition, Associated Iliffe Press, Dorset House, Stamford St., London S.E.1, England, stating for which sessions they are required.

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Large-area variable-section moldings like this Apex Wash•A•Matic laundry machine tub are readily produced at The Apex Electrical Manufacturing Company from Glidden GLIDPOL* reinforced with glass fibers.

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GLIDPOL is a family of polyester resins formulated to meet any molding and service requirements. GLIDPOL can be potted or cast, laminated or molded. It can also be used in making parts to meet any service requirements: corrosion-resistance, weather-resistance, high dielectric strength, high structural and impact strength, and superior wet strength.

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**THE GLIDDEN COMPANY** • INDUSTRIAL FINISHES DIVISION • 11005 MADISON AVENUE, CLEVELAND 2, OHIO

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# CLASSIFIED ADVERTISEMENTS

MODERN PLASTICS reserves the right to accept, reject or censor classified copy.

**EMPLOYMENT • BUSINESS OPPORTUNITIES • EQUIPMENT (used or resale only)**

## MACHINERY and EQUIPMENT FOR SALE

AVAILABLE AT BARGAIN PRICES
Mitts & Merrill 15CD Rotary Cutter. J. H. Day, from ¾ up to 100 gal., Imperial and Cincinnatus D.A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Baker Perkins Heavy Duty Steam Jacketed, Double Arm, from 5 to 200 gal., Mixers (Unidor and Vacuum also), Gemco 2000 lb. 56 cu. ft. Double Cone Blender. Mikro Bantam 1SH, 2TH, 3W, 4TH Pulverizers, Rotex, Tyler Hum-mer, Robinson, Raymond, Gayco, Great Western Sifters. Colton 2 RP and 3 RP Rotary & #5½ Tablet Machines. Carver Laboratory 20 ton hydraulic Press. Package Machy. FA, FA2, FA4, U4, Miller, Hayssen, Wrap-King, Scandia, Oliver Auto. Wrappers—all sizes. This is only a partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements.
UNION STANDARD EQUIPMENT CO.
318-322 Lafayette St., New York 12, N.Y.

KUX 2½" Dia. Single Punch Preform Machine. Leominster 8 oz. Injection Molding Machine. Plastic and Rubber Equipment. Farrell 16"x48", 15"x36" and 6"x12", 2 roll mills. Mills and Calenders up to 84". New Seco 6"x12" and 6"x16" Lab. Mixing Mills and Calenders. Rubber Plastic Extruders Wat.-Stillman 75 ton automatic Molding Press 20"x20" platens. 200 ton Hobbing Press 18"x14" platens. HPM 200 ton 30"x48" platens. New Loomis 340 ton. 24"x56" platens. 200 ton Brunswick 21"x21" platens, 14" ram. 150 ton Bolling 20"x20" platens. Southwark 30 ton 14"x14" platens, semi-auto. Also Lab to 2000 tons from 12"x12" to 48"x48". Hydr. Oil Pumps. Gould 75 HP motor Dr. 2 stage Centrif. Pump 250#. W.S. 4 Plgr. High and Low Pressure Hydr. Pump. Elmes Hor. 4 Plgr. 4500 lbs. and 5500 lbs. Hydr. Accumulators. Stokes Automatic Molding Presses. Rotary & single Punch Preform Tablet Machines ⅛" to 4". Injection Molding Machines 1 oz. to 32 oz. Baker Perkins Jacketed Mixers. Plastic Grinders. Heavy duty mixers, gas boilers. Partial listing. We buy your surplus machinery. STEIN EQUIPMENT CO., 107-8th Street, Brooklyn 15, N.Y. STerling 8-1944.

SAVE WITH GUARANTEED REBUILT EQUIPMENT: 2 new R. D. Wood 500 ton embossing presses; 54"x26" platen, HYDRAULIC PRESSES; 40"x54", 36" ram, 1500 tons; 30"x26", 16" ram, 600 tons; 2—27"x27", 18" rams, 585 tons; 20"x20" 10" ram, 200 tons; 20"x20", 14" ram, 200 tons; 15"x15" 8" ram, 75 tons; 14"x14" 8" ram, 75 tons; 2—19"x24" 10" rams 78 tons; 18"x18," 7" ram, 50 tons; 10—26"x26" 7" rams, 50 tons; 12"x12" 7½" ram, 50 tons; 14"x14" 8" ram, 50 tons; 8"x9½" 4½" rams 20 tons; 16"x16" 3½" rams, 12 tons; Carver model 150 and 6"x 6". LABORATORY PRESSES: Stokes Model T, late type with drive; Stokes Model T, late type with hydraulic equalizer system and drive; Colton 5½T with drive PREFORM PRESSES; NEW UNIVERSAL DUAL PUMPING UNITS 3—15 HP; NEW LABORATORY MILLS and CALENDERS; HPM 6" ram, 2500# pressure ACCUMULATOR; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. UNIVERSAL HYDRAULIC MACHINERY COMPANY, INC., 285 Hudson Street, New York 13, N. Y.

FOR SALE
Lester 3S-27-12 Injection Molding Machine 12 ounce capacity. Excellent running condition, can be seen in operation.
STERLING PLASTICS CO.
1140 Commerce Avenue, Union, New Jersey

FOR SALE: Stainless Steel Rotary Dryer, Link Belt Co., 5'2"x16', No. 502-16, with all auxiliary equipment. Roto Louvre type. Reply Box 43155, Modern Plastics.

COMPLETE PLASTIC BUTTON MOLDING PLANT: 1—Stokes 200 Ton Model 250-A Semi-automatic Press, 2—Stokes 150 Ton Model 250-A Semi-automatic Presses, 3—Stokes RDS-3 Rotary Tablet Machines, 3—MKO 2 HP, 150 PSI Gas Boilers, 3—Buttondex Broaches, Definners, Inspection Conveyors, Tumbling Barrels, 18, 22, 24, 30 Ring Fisheye, Poker Chip and Electric Plug Molds, etc. Other Hydraulic Presses: Erie 4000 Ton and Baldwin-Southward 3600 Ton Belt Presses. Birdsboro 2000 Ton, Farrell 1000 Ton, HPM 750 Ton, Erie 700 Ton, Baldwin-Southwark 400 Ton, Farrell 393 Ton and 200 Ton, Watson-Stillman 110 Ton and 100 Ton, HPM 100 Ton and 35 Ton Molding Presses and Watson-Stillman 30 Ton Lab Presses. INJECTION MOLDING MACHINES: Various Makes, 2 oz. to 22 oz. EXTRUDERS: No. 1 Royle and larger. MISCELLANEOUS: Lab Mixers and Mills, MPM Pelletizer, Rotary Cutters, etc. JOHNSON MACHINERY COMPANY, 683P Frelinghuysen Avenue, Newark 5, New Jersey. Bigelow 8-2500. What have you for sale? What are you looking for?

FOR SALE: Hobbing Press 800 Ton W.S. (2) 300 Ton W.S. Presses 20x20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen Ball & Jewell Plastic Grinders. Standard Mystic Embossing Presses. Accumulators, Pumps, Valves. Many other Presses—Send For Bulletin. AARON MACHINERY CO., INC., 45 Crosby St., New York 12, N. Y. Tel. WAlker 5-8300.

(5) NEW WATSON-STILLMAN EJECTION Molding Heating Chambers, one four ounce, one six ounce, two eight ounce, one sixteen ounce. Price one third the cost of new. New 75 ton presses, size 22x22, 10" ram, 10" stroke, $1100 each, ten day delivery f.o.b. Brooklyn, New York, one or more can be obtained. HYDRAULIC SAL-PRESS CO., INC., 388 Warren Street, Bklyn., N. Y.

FOR SALE: Blaw-Knox 15 gallon Resin Kettle Pilot Plant, type 347 stainless steel, jacketed and agitated, 150# pressure, with Condenser and Receiver, Variable speed drive, Controls, etc. Excellent condition. PERRY EQUIPMENT CORP., 1429 North 6th Street, Philadelphia 22, Pa.

1—STOKES 200 Ton Hydraulic, Single Punch Press 10"x6" preform x5" depth of fill.1—National 10"x20" two roll Mill with 25 HP motor; 1—Baker Perkins 100 gal. S.S. double arm jacketed Vacuum Mixer; 2—Baker Perkins, Readco 100 gal. Jacketed double arm Mixers; 1—Baker Perkins 50 gal. double arm jacketed Mixer 50 HP motor; 4—Stokes Rotary Preform Presses DD2, DDS2, D4 and D3; 1—Kux Model 15-25 double action Rotary Press; Also: Sifters, Cutters, Banbury Mixers, etc., partial listing; write for details; we purchase your surplus equipment. BRILL EQUIPMENT CO., 2407 Third Ave., New York 51, N. Y.

HYDRAULIC COMPRESSION Molding Presses, used but good condition, 8 different sizes, platens from 48"x48" down to 14"x10" available Chicago and East, ready for inspection, prompt shipment and reasonably priced; also new Laboratory Presses. ERIC BONWITT, 431 South Dearborn Street, Chicago 5, Illinois. Specializing in Machinery for the Plastic Industry.

FOR SALE: 2—Farrel 50" mills; 1—Farrel 2 roll calender 9"x20" with conveyor; 3—16"x42" Farrel mills; 2—28" ram Dunning & Boschert hydraulic presses; 1—18" ram Farrell press; 2—16" ram Southwark presses; 1—12" ram Boschert press; 2—8" ram Watson Stillman presses; 1—Cumberland grinder; 1—Rotex sifter, also other rubber and plastic machinery. RELIABLE RUBBER & PLASTIC MACHINERY CO., INC. 2014 Union Turnpike, North Bergen, N.J. Tel.: Union 5-1073.

FOR SALE—INJECTION MOLDING MACHINES. One Lester 12½-12 oz. (Ser. #466), new 1948, used only ½ of time; adapted for molding nylon. One Lester L-2½-8 oz. (Ser. #396), new 1949, used very little. Both machines in good condition. Can be seen molding clear acrylic automotive parts. Spare heaters, plungers, feed cylinders at reduced prices. Located Mich. Reply Box 40955, Modern Plastics.

FOR SALE: One Hudson-Sharp Packaging Machine, Model: Campbell Wrapper, Serial No. 2W8-651, 230V, 3PH, 50 cycle, 5 amp. In excellent condition. Like new. Used only 20% of time since purchased in 1951. Will guarantee. Price $7500.00, F.O.B. Circleville, Ohio. Reply Box 41455, Modern Plastics.

FOR SALE: 2—380 ton compression molding presses, 28"x30", 20" ram; 2—HPM 225 ton molding presses, 40"x40" platen area; 1—Ball & Jewell #2 rotary cutter, 40 HP motor; 2—Stokes Model 294 pre-form presses, 4" tablet; 1—Colton 5½T pre-form press, 3" tablet; also mills, extruders, mixers, et cetera. CHEMICAL & PROCESS MACHINERY CORP., 148 Grand Street, New York, N. Y.

FOR SALE: Injection Presses: 8, 12, 32 oz. Reed; 6, 12 oz. Lester; 9, 16, 40 oz. HPM; 1 oz. Van Dorn; 4 oz. Impco. Extruder Conveyors. Scrap grinders. Ovens. Compression & Transfer presses: 50, 100, 250 & 600 tons. Preform presses: Defiance No. 20; Stokes No. 280 C. 42" Slitting & Rewind machine. 1000 ton Elmes Hobbing Press. Read 6 qt. mixer. Equipment to be inspected in operation. List surplus equipment with me. JUSTIN ZENNER, 823 Waveland Avenue, Chicago 13, Ill.

FOR SALE: One Model LC 2-18" DPI double vacuum coating unit, purchased in 1951, first-class condition, little use. $5500.00, f.o.b. our plant. FRANKLIN PLASTICS, INC., Franklin, Pennsylvania.

FOR SALE (USED): Electronic Heat Sealing Equipment; generators and presses for plastic sealing. Leading make, good condition, reasonable. Reply Box 42555, Modern Plastics.

FOR SALE: 1—F.B. 32"x92" inverted-L 4 Roll Calender, reduction drive, d.c. vari-speed motor; 1—Royle #4 Extruder, motor driven; 1—6"x12" Laboratory Mill, m.d. 1—Farrell-Birmingham 6"x13" 3 Roll Calender; 1—Ball & Jewell Rotary Cutter, Model 251, m.d.; 2—Baker-Perkins Size 15, 100 gal. Jacketed Mixers; 5—Horizontal Dry Powder ribbon Mixers. 4000#, 1500#, 500#; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Farrell-Birmingham 60" Mill with reduction drive, 150 HP motor, floor level mounting; 1—Fitzpatrick "D" Comminutor, S.S. contact parts, jacketed; 1—Mikro Pulverizer #2th, with motor; 4—Reed Prentice & W-S Injection Molding Machines, 2-16 oz.; 4-Hymac 125 ton Molding Presses, 16"x16" electrically heated platens. Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N.J. HOboken 3-4425. N. Y. Tel. BArclay 7-0600.

FOR SALE: (1) La Rose Thermall Heat Sealer, for Vinyl & Acetate, 1 KW-110 Volt, single phase-60 cycles, original cost $1600.00, practically new, will sacrifice for $700.00. (1) Globe Power acetate creaser & bender, original cost $950.00 will sacrifice for $350.00. JESSE JONES BOX CORP., Box 5120, Philadelphia 41, Pa.

(Continued on page 278)

# For precision and versatility—choose

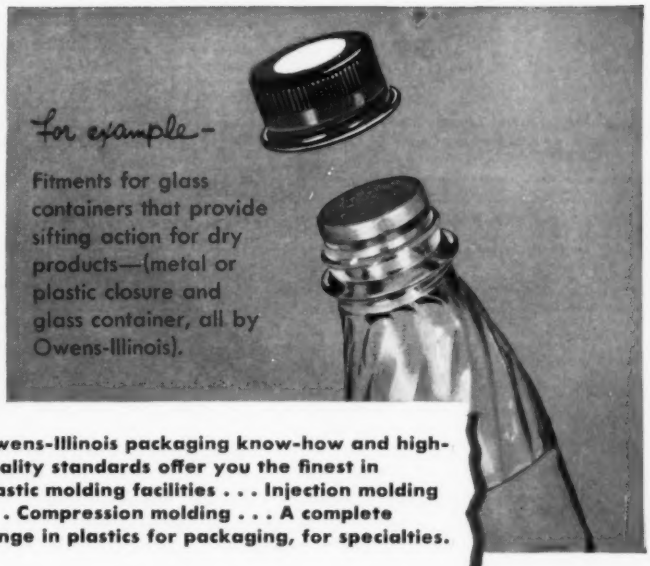
# OWENS-ILLINOIS for PLASTICS

*For example—*

These spouts and caps are air- and liquid-tight. Designed for easy dispensing, these colorful fitments improve the sales appeal and reduce the cost of aerosol shaving lather containers. Owens-Illinois has extensive experience manufacturing plastic spouts for other products such as whipping cream, insecticides, sprays, etc.

*For example—*

This no-drip plastic fitment for liquid condiments simply slips on top of bottle. Plastic closure gives a positive, leak-proof reseal.



*For example—*

Fitments for glass containers that provide sifting action for dry products—(metal or plastic closure and glass container, all by Owens-Illinois).

**Owens-Illinois packaging know-how and high-quality standards offer you the finest in plastic molding facilities . . . Injection molding . . . Compression molding . . . A complete range in plastics for packaging, for specialties.**

*Branch Offices:*

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| Albany . . . New York | Columbus . . . Ohio | Memphis . . . Tennessee | Portland . . . Oregon |
| Atlanta . . . Georgia | Dallas . . . Texas | Milwaukee . . . Wisconsin | Richmond . . . Virginia |
| Baltimore . . . Maryland | Denver . . . Colorado | Nashville . . . Tennessee | Rochester . . . New York |
| Birmingham . . . Alabama | Detroit . . . Michigan | New Orleans . . . Louisiana | St. Louis . . . Missouri |
| Boston . . . Massachusetts | Fresno . . . California | New York . . . New York | St. Paul . . . Minnesota |
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| Cincinnati . . . Ohio | Los Angeles . . . California | Philadelphia . . . Pennsylvania | Yakima . . . Washington |
| Cleveland . . . Ohio | Louisville . . . Kentucky | Pittsburgh . . . Pennsylvania | |

OWENS-ILLINOIS PLASTICS
AN (O) PRODUCT

OWENS-ILLINOIS
GENERAL OFFICES • TOLEDO 1, OHIO

# CLASSIFIED ADVERTISING

(*Continued from page 276*)

VACUUM FORMING MACHINE in excellent condition double bed 48x90; also complete water wash spray booth for making metal spray molds; complete with gun and attachments; sacrifice. DECORATIVE PLASTICS CO., 3876 Park Ave, Bronx, N.Y. CY 9-9092.

## MACHINERY and EQUIPMENT WANTED

WANTED:
Extruders and Conveying equipment. We are manufacturers, not dealers. Reply Box 43655, Modern Plastics.

WANTED: Machinery including Rubber Mills, Hydraulic presses, Study mixers, Calenders, Banbury mixers, Pulverizers, Grinders, Rotary cutters, Extruders, Screens, Injection Molding machines, Dryers. Will purchase complete plant. CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425. N. Y. Tel.: BArclay 7-0600.

WANTED: 60" Cavagnaro, hydraulic, 2 roll embossing calender. Must be in good shape. Write full details to: Box 41155, Modern Plastics.

WANTED: 150 Ton Molding Press, Stokes R4 Preform Press, 8 oz. Injection Molding Machine, No. 3 Banbury Mixer, Calender, Extruder. Give particulars. Reply Box 43255, Modern Plastics.

WANTED—Two 8-oz. Reed Prentice molding machines in good condition. Reply in writing, giving serial number, year and best price. WILSON PLASTICS, INC. 1531 Milan Road, Sandusky, Ohio.

## MATERIALS FOR SALE

FOR SALE: High Impact Polystyrene. You can save money by using our Reprocessed High Impact Polystyrene pellets available in a variety of bright colors as well as matched colors. Also, bargains in bright colors Cellulose Acetate and other thermoplastics. 8,000 lbs. Virgin Gray Pearl-effect Polystyrene. 15,000 lbs. low priced Virgin Black Cellulose Acetate. Samples on request. A. BAMBERGER CORPORATION, 703 Bedford Ave., Brooklyn 6, N. Y., Telephone MAin 5-7450.

FOR SALE: 20,000 lbs. each Red and Blue Styrene Pellets. Surplus lot Red Acetate Pellets—15,000 lbs. Both attractively priced. We are also in the market for all surplus plastic scrap and powder. PLASTIC MOLDING POWDERS, INC., 2004 MacDonald Avenue, Bklyn., N. Y. Tel.: ES 5-7943.

FOR SALE: 20,000 pcs. reinforced fibreglass discs, 6½" dia. x 1/16" thick. Weight, 2¼ oz. Tensile of 12,000 lbs. Corrosion and rust-proof. Can be punched, drilled, sheared and machined. Clean, first-grade quality. Mostly salmon color, balance yellow. Price, 5c ea. E. L. Frantz, APEX ELECTRICAL MANUFACTURING CO., 1070 E. 152nd St., Cleveland 10, Ohio.

## MATERIALS WANTED

WANTED: Plastics Scrap and Rejects of all kinds, ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid. A. BAMBERGER CORPORATION, 703 Bedford Ave., Brooklyn 6, N. Y., Telephone MAin 5-7450.

CLEAN SCRAP WANTED. Good prices paid for good quality sheet, film, trimmings, sprues, runners, rejects, bleeder lumps, surplus. Need all thermoplastics—polyethylene, rigid and flexible vinyl, regular and impact styrene, cellulosics, acrylic, nylon. Reply Box 42455, Modern Plastics.

SELL US YOUR PLASTIC SCRAP. Polyethylene, Polystyrene, Acetate, Ethyl Cellulose, Acrylics, Butyrate, Nylon. GEORGE WOLOCH, Inc., 82 Beaver St., New York 5, N. Y.

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. DUKE PLASTICS CORP., 584 Broadway, Brooklyn 6, N. Y. Note new address!

CLEAR ACRYLIC MOLDING POWDER scrap wanted by end user either reground or unground. VS-100, HM-129, HM-130. Highest cash prices paid. Reply Box 41655, Modern Plastics.

SCRAP PLASTICS, all forms, waste and surplus plastic molding materials, rejects in any form. We will also buy your obsolete inventories of molding powders, stabilizers, plasticizers and other plastic and chemical materials. ACETO CHEMICAL CO., INC., 40-40A Lawrence St., Flushing 54, N. Y. INdependence 1-4100.

INTERESTED IN PURCHASING odd lots of resin and off resin. Any quantity, large quantities preferred. Reply in detail sending samples and identify material offered. Reply Box 43355, Modern Plastics.

## MOLDS FOR SALE

FOR SALE OR EXPORT: Metal drape and vacuum forming shell molds of Xmas items for illuminated displays. Santas (all sizes), sleighs, candles, angels, reindeer, candy canes, bells, etc. All for half of original cost. Also many other molds in stock for novelties, etc. Reply Box 43755, Modern Plastics.

## PLANTS WANTED

WANTED POLYETHYLENE FILM MANUFACTURING PLANT: Will buy interest in plant for production and sales of Polyethylene seamless tubing and film. Desires Eastern location. Personnel must be aggressive and have thorough experience in manufacturing techniques and be ready for fast growth with added capital. Reply Box 40355, Modern Plastics.

EXTRUSION AND VACUUM FORMING PLANT WANTED: A large plastic molder will furnish capital and sales organization for expanding Styrene extrusions and vacuum forming. Prefers location in Midwest area. Desires plant sufficiently staffed for rapid expansion. Reply Box 40255, Modern Plastics.

## PLANT FOR SALE

FOR SALE
Complete wood flour mill. Capacity 10 tons per 24 hours, using nearby supply of pine and poplar. For further particulars, reply Box 41755, Modern Plastics.

## HELP WANTED

BRAZIL—Large molder desires one or several men experienced Reed-Prentice machines possibly supervising tool shop making molds layouts for assembly—extremely attractive proposition. Reply Box 41355, Modern Plastics.

TOOL DESIGNER
With 10 to 15 years experience on plastic injection or die casting molds. Knowledge of injection molding equipment desired. Excellent opportunity with well established proprietary molder in Greater New York area. Position open as result of retirement. Please furnish complete resume and state salary desired. Reply Box 42755, Modern Plastics.

ENGINEER—Excellent opportunity for an engineer experienced in the design and manufacture of compression molded plastic products. Background must include drafting and manufacturing experience. Position is open in Detroit plant. WOODALL INDUSTRIES INC., 7565 E. McNichols Rd., Detroit 34, Michigan.

FLOOR TILE CHEMIST WANTED
Experienced manufacture Vinyl Tile. Good salary, liberal insurance, hospitalization and retirement. Replies will be confidential. Reply Box 40555, Modern Plastics.

ENGINEERS For Design and Sales: In medium sized Mid-West plastic manufacturing division of nationally known concern. Position involves customer contact for product design, development and promotion. Background in electrical packaging, or aircraft industries preferred, but not essential. Please give complete resume in initial response. Reply Box 41055, Modern Plastics.

DEVELOPMENT ENGINEERS
Product & Process
Established company has opening for one product development engineer and one process development engineer. Prefer chemical engineer with some experience in paper or synthetic resins. Unusual opportunity for permanent connection and growth potential. In reply give full details of age, education, experience and salaries. Reply Box 40855, Modern Plastics.

PIGMENT CHEMIST with experience in evaluation of pigment, plastics, printing inks, paints and rubber. $5,000-$6,000 to start. Reply Box 41955, Modern Plastics.

EXTRUSION OPERATOR
Set-up man with wide experience to assist supervisor in long established extrusion plant New York City. Will help relocate. Reply Box 40455, Modern Plastics.

COMPRESSION ENGINEER—We are looking for a compression engineer for our plastics molding division in the Chicago area. 2 to 3 years of practical compression molding experience essential. Engineering degree desirous but not necessary. A challenge for the right man. All replies will be held in strict confidence. Reply Box 42155, Modern Plastics.

(*Continued on page 280*)

*Our photograph shows the Vickers-Armstrong 'Viscount', one of the latest British aircraft which has been ordered by leading airline Companies in North America, Australia and other countries throughout the world.*

# 'PERSPEX' on top

'Perspex' is the acrylic sheet specified for British civil and military aircraft supplied to the R.A.F., Commonwealth and N.A.T.O. Air Forces, and to international airline operators. It has withstood the test of time in aircraft operating at all heights in all parts of the world and this proven material is now naturally preferred for the latest forms of air transport. Clear 'Perspex' acrylic sheet is used for windows and the opal and coloured grades are used for lighting fittings, window framings, panelling and other decorative fitments.

*'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.*

IMPERIAL CHEMICAL INDUSTRIES LTD., PLASTICS DIVISION, BLACK FAN ROAD, WELWYN GARDEN CITY, HERTS, ENGLAND.

U.S.A. ENQUIRIES TO: J. B. HENRIQUES INC., 521 FIFTH AVENUE, NEW YORK 17, N.Y.

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OP1

# CLASSIFIED ADVERTISING

(Continued from page 278)

PLASTICS ENGINEER
Production and Development Engineer; experienced in formulation, evaluation and competitive analysis of all phases of dry blends and conventional extrusion compounds, plastisols, surface coatings, adhesives and sealers. Plant is located in Northwestern Ohio. Reply, stating age, education, experience and salary requirements. Reply Box 42055, Modern Plastics.

SALESMAN Plastic-Glass Container or Metal Tube following essential. Aggressive hard hitting type, one willing to grow with energetic sales organization—offers position with opportunities New York-New Jersey-Connecticut-Philadelphia-Baltimore areas. Reply Box 42855, Modern Plastics.

WE ARE EXPANDING and have openings for men experienced in thermoplastics, in the following departments:

1) Sales and Technical Service. Buying, selling, trading. East and Midwest. Some travel, possibly relocation.
2) Research and Development on formulations, compounds, colors and colorants. New product development. Location: Brooklyn, N. Y.

We offer the opportunity to come in on the ground floor of our rapidly growing organizations. Send resume stating salary required to Gerald F. Bamberger, Exec. V. P. All replies held in strict confidence. A. BAMBERGER CORPORATION and affiliated AMERICAN MOLDING POWDER AND CHEMICAL CORPORATION, 703 Bedford Ave., Brooklyn 6, N. Y.

POLYETHYLENE FILM ENGINEER: Experienced in the manufacture of extruded seamless tubing and film. Large plastic fabricator wants to expand into that field. Wonderful opportunity for right man with a thorough background experience capable of setting up small modern production plant designed for rapid growth. Send full resume of qualifications and experience. Reply Box 40055, Modern Plastics.

CHEMIST—VINYL COATING
Require chemist experienced plastisol formulations for fabric coating operation. Good opportunity. All replies confidential. Our employees know about this ad. Reply Box 40755, Modern Plastics.

WANTED FOR PLASTICS EVALUATION
Man thoroughly experienced in testing and evaluation of plastics, including polyesters, vinyls, epoxy, phenolic, etc., for use in field of moldings, adhesives, laminants, foams, etc. Applicant should have sufficient training and experience to make recommendations concerning possible industrial applications of new polymers developed in our Research Laboratories. Graduate chemists, chemical engineers or physical chemists desiring further information should forward resume, photo and salary requirements to: Mr. C. M. Jackson, DEVOE AND RAYNOLDS COMPANY, INC., P.O. Box 328, Louisville, Kentucky.

ENGINEERS — SALESMEN — ADMINISTRATORS — EMPLOYERS: Confidential, rapid and professional service for nation wide placement in the Plastics field. Write giving age, education and brief experience. Employers send us job description. We will let you know how we can help you by return mail. GRAEBNER'S PLASTICS EXCHANGE "The Nation's Largest", 116 South Michigan, Chicago 3, Illinois.

EXTRUSION AND VACUUM FORMING ENGINEER: To set up and operate custom production facilities in Styrene sheet. To locate in Midwest near potential volume production center. Reply Box 40155, Modern Plastics.

VINYL CHEMIST
Experienced heavy or light gauge calendering. Good salary, liberal insurance, hospitalization and retirement. Replies treated confidentially. Reply Box 40655, Modern Plastics.

GENERAL FOREMAN with injection molding experience for Norwalk, Connecticut plant of injection molding firm. Excellent opportunity for right man. Six presses up to 16 oz. Company has two other plants. Generous salary and other company benefits. Reply Box 43055, Modern Plastics.

## SITUATIONS WANTED

ACQUIRE EXPERT TECHNICAL SKILL and ideas without increasing your full-time personnel. Chemical Consultant with strong background in plastics research, product and market development. Extensive experience in polymerization, plastics formulation and processing, upgrading of scrap. Registered Patent Agent; member, Association of Consulting Chemists and Chemical Engineers. IRVING SKEIST, Ph. D., 14 Edgar Street, Summit, New Jersey. Summit 6-0245.

NEW PRODUCTS ENGINEER, Graduate, 12 years solid diversified experience on new products from first sketches to efficient production. Experience includes mechanical, electromechanical, broad plastics, rubber latex, photographic, high vacuum, instrumentation, testing, specifications, and group leading. Creative, cooperative, tenacious and highly resourceful throughout all phases of development. $10,000. Reply Box 41555, Modern Plastics.

PLANT SUPT.-GENERAL FOREMAN—Over 12 years experience all phases injection molding. First class inside man knows set up and operation of plant from A to Z. Time study, efficiency, set up, maintenance, cycling, overall plant coordination, quantity-quality control systems, tight supervision all levels. Good labor relations. Wishes to relocate Florida or any all year temperate zone state. Reply Box 42355, Modern Plastics.

PLASTICS CHEMIST — engineer executive abilities 20 years experience in silver spray and vacuum metallizing at inexpensive mass production for toys, jewelry, Christmas items, further on rubbers and adhesives desires new connections US and abroad. Reply Box 42955, Modern Plastics.

## SALES AGENTS WANTED

CUSTOM INJECTION and compression molder seeks Manufacturers' representative. Our Company is relatively small but has heavy experience; is located in Philadelphia area. KESICH MANUFACTURING CO., INC., 10 Esplanade Avenue, Pitman, New Jersey.

## MISCELLANEOUS

GERMAN MANUFACTURING CO. (tooled parts and valves) wants to make an arrangement of mutual benefit with U.S. Plastics Manufacturers. General manager visits in April New York-Chicago area, a chance, to talk things over. Cooperation for building up special department and acquiring license of newest process desired. If partnership wanted, there are certain possibilities given. Reply Box 43555, Modern Plastics.

EXPORTERS WANTED: To handle line of colorants for Injection Molding, Extrusions, and Polyester fiberglas fabrications. Reply Box 42655, Modern Plastics.

COATED FABRICS CONSULTANT: 30 years experience with coated fabrics in development, research and sales. Expert on vinyl coatings, plastisols, organosols, plasticizers, pigments. Available for full time or professional services. Salary can be arranged. Experience includes responsible positions with leading coated fabric manufacturers. References provided. Reply Box 42255, Modern Plastics.

INTERESTED IN PURCHASING: Dimethyl Phthalate, Diethyl Phthalate, Tricresyl Phthalate, Ortho-Nitrobiphenyl, Ethox Methox, Di Carbitol, Pycal 94. PEERLESS CHEMICAL CORP., 181 Greene Street, N.Y.C. 12.

REINFORCED PLASTICS. Chemical engineer, experienced in all phases of reinforced plastics field—design, development, production. Available for consulting assignments here or abroad. Reply Box 41855, Modern Plastics.

BEST RECOMMENDED GERMAN wholesaler exporter and importer with excellent connections to the Plastic Industry wants agency for raw materials like Polystyrene, special grades, Polystyrene sheets for vacuum forming, Polyethylene etc. for Germany. Reply Box 41255, Modern Plastics.

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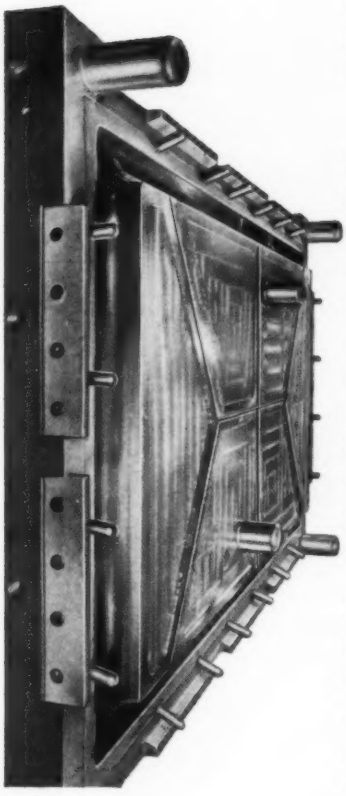

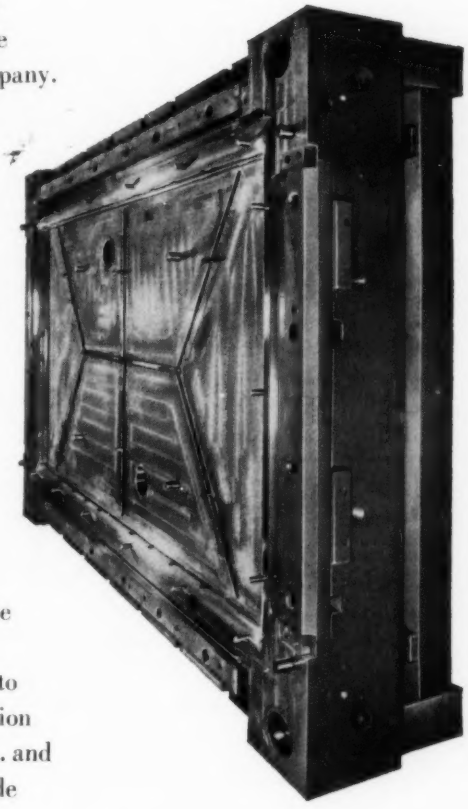

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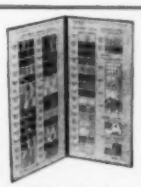

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